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TWENTY-FIVE YEARS OF BIOCHEMISTRY[1]

TWENTY-FIVE years ago I gave my last lecture in America as an instructor in chemistry in Harvard University, after two years of industrial and two years of academic work in this country. I did not then expect ever again to address an American audience, and even less did I anticipate the honor of being allowed to report in this great university about the special work to which I have devoted all my interest and energy during the last two and a half decades. I wish therefore first of all to express my sincere thanks to Professor Dennis and Cornell University for the invitation which affords me this opportunity.

As an introduction, it would seem best to attempt a short historical review of the branch of science that is generally termed "biochemistry." Because of the limited scope of this lecture I will define biochemistry in a somewhat arbitrary manner, as the chemistry of physiologically important organic substances which are essential to the living organism of animals or plants.

Biochemistry as a special branch of study or as a particular field of instruction is of quite recent origin, and a history of biochemistry has not yet been written. In the brief time at my disposal this evening it would be quite impossible adequately to review the progress in this branch during the last quarter of a century, and I will therefore attempt merely to outline the chief developments in this field. Detailed discussions of the progress may be found in the writings of that important contributor to biochemical literature, Oppenheimer.

In earlier times when experimental chemistry was exclusively in the hands of physicians and pharmacists, who by the nature of their work should especially have been interested in biochemistry, very little progress was made. The reason for this lies in the fact that important biochemical substances were very complex, a characteristic which renders their investigation difficult. Before entering upon the study of such substances it was necessary that precise knowledge of inorganic substances and reactions should first be gained, and the successful investigation of these bodies naturally had to be preceded by adequate

[1] Introductory public lecture by Professor Hans Pringsheim, of the University of Berlin, non-resident lecturer in chemistry at Cornell University.

development of organic chemistry, the one hundredth birthday of which we are celebrating this year. The earlier investigators rarely studied material of biological origin and only the great leaders in the science had the courage to enter upon this field. If we except the fundamental work of Chevreul on the constitution of the fats, which are in many ways the simplest biological compounds, the investigations of that period must, from the present-day standpoint, be regarded as preparatory only. One biochemical process, however, that of alcoholic fermentation, early attracted the interest of chemists. In the first half of the last century Gay-Lussac studied the question of the decomposition of sugar by yeast, and Pasteur and Liebig entered into their celebrated controversy concerning the causes of this decomposition. To Eduard Buchner we are indebted for the discovery that the enzyme which catalyzes the decomposition of sugar into alcohol and carbonic acid may be separated from the cell of the living yeasts. Emil Fischer devoted most of his attention to substances of biological origin. Most of his researches on sugars and purines preceded the period of which I am speaking, but his investigations on proteins and tannins belong to it.

Twenty-five years ago there existed only one journal devoted to the subject of biochemistry, the *Zeitschrift für physiologische Chemie,* which Hoppe-Seyler founded in 1877. About twenty-two years ago the *Biochemische Zeitschrift* first appeared in Germany, the *Biochemical Journal* in England and the *Journal of Biological Chemistry* in this country. In 1922 the Japanese *Journal of Biochemistry* was started. Interest in this field has so rapidly developed that the reports of investigations in biochemistry fill not merely the journals which I have just mentioned but form substantial parts of the reports of the meetings of the various chemical societies. New chairs of biochemistry are being endowed, new laboratories with special equipment are being constructed in various universities and institutes devoted exclusively to research, such as the Rockefeller Institute for Medical Research in New York City, the Rockefeller Foundation in Stockholm and the Kaiser Wilhelm Institute in Germany. We thus see that biochemistry is attaining equal rank and equal recognition with inorganic, organic and physical chemistry.

We can, perhaps, best follow the development of biochemistry by considering separately the three groups of substances that are most essential to the living cell, namely, the fats, the sugars and the proteins. In this discussion I shall have occasion to refer to other substances more or less directly connected with these bodies.

The Fats

The fats, which are the principal reserve substances of the body, are esters of glycerol with long-chain fatty acids. A large part of the necessary living energy is supplied by their oxidation. Now such compounds as the fatty acids of the paraffin series are very resistant, and it is difficult to explain how their oxidation could take place under the mild conditions of cellular life. It was, therefore, a great achievement when Knoop and others showed that the oxidizing forces attack by preference the second carbon atom from the carboxyl group (the beta carbon atom) so that step by step two carbons are always split off until finally the whole chain is broken down into water and carbon dioxide.

Closely related to the fats are the lipoids which contain, in addition to the fatty group, phosphoric acid and a basic substance in the molecule. The lipoids form part of every living cell and are of primary importance in the regulation of the passage of food substances through the cell members. Levene, of the Rockefeller Institute in New York, has made a special study of the phosphatides and was the first to prepare a really pure lecithin. His work on the related cephalin of the brain is also noteworthy.

Fats are insoluble in water and in the normal medium of the digestive tract. For their transportation and digestion they must be distributed so as to expose a large surface and this is arrived at by emulsion. The bile secretes a juice which passes into the intestines and has a special power to dissolve the fats. The principal organic substances of the bile are the so-called bile acids, hydroaromatic compounds of complicated structures, which have been the subject of the investigations of Wieland, Schenk, Borsche and others. It is interesting to note that cholesterol, which also forms part of the bile, and is accumulated in the bile stones, is, according to Windaus, constitutionally closely related to the bile acids. One of the most important results of biochemical research is the discovery by Windaus in Germany, Rosenheim in England and Hess in America that ergosterol, a compound belonging to the cholesterol group, under the influence of ultra-violet rays, is transformed into an accessory food substance or vitamin. A new and important field of biochemical work and one of great promise from the medical aspect has been opened up by these investigations.

The Sugars

The sugars form another group of important biochemical substances. They are made up of carbon, hydrogen and oxygen. Emil Fischer has made clear the structure of the simple sugars, such as glucose,

fructose, mannose and others, through his classical investigations, and he determined their structural configuration on the basis of the stereochemical laws which had then just been enunciated by LeBel and van't Hoff. Fischer succeeded in synthesizing the above monosaccharides and studied their behavior toward enzymes. One of his greatest achievements was the discovery of the specific qualities of these biochemical catalysts, an observation that has been of outstanding importance in the development of this branch of biochemistry. Many scientists have contributed to our knowledge of sugar chemistry, among them being Kiliani, Lobry de Bruyn, Bertrand and Bourquelot. Tanret prepared for the first time the two stereochemical forms of glucose which we now call alpha glucose and beta glucose.

In the early part of the twentieth century Emil Fischer devoted himself to the tannins, a class of substances chemically derived from the sugar molecule by substitution with the residues of gallic acid. This work was continued and developed chiefly by his pupil Freudenberg.

After his early work on the sugars Fischer discontinued for a time his investigations in this field, but during the last years of his life he again took up the study of these bodies and discovered a number of important changes in the glucose molecule, which were developed by his coworker, Bergmann, and which inaugurated a new period in sugar chemistry. We are still living in this era; it has spread over the whole world, and it is not an exaggeration to say that there is now appearing in chemical journals about one article a day that has some bearing on the chemistry or biochemistry of the carbohydrates.

A new impulse was given by the discovery by Hudson, of the Bureau of Standards in Washington, of certain rules, based upon the additive quality of the rotatory power, which relate the optical rotations of the sugars and their derivatives under mathematical rules. Hudson and also Levene have demonstrated the validity of these rules which in many cases enable us to predict the specific rotation of unknown sugars, and to draw conclusions from the rotatory power concerning the constitution and configuration of simple and complex carbohydrates.

In the field of the disaccharides and the trisaccharides the recent advance is quite remarkable. The constitution of such disaccharides as maltose, lactose, cellobiose, gentiobiose and others has been cleared up by the methylation process, which for many years was investigated by Purdie and Irvine, of St. Andrews University, and which has lately enabled Irvine and Haworth to make a definite formulation of the constitution of these substances. Their conclusions were later confirmed by Zemplén, of Budapest, who used a different method. It was discovered that cane-sugar contains, in its fructose portion, a special form of an unstable sugar molecule, a gamma sugar, which after inversion changes into the stable form. Such unstable sugars are formed preferentially as intermediate products in the natural assimilation processes of plants and animals, in the metabolism of starch, glycogen and inulin.

One of the chief aims of the chemist, the synthesis of some of the polysaccharides of established constitution, has now been attained. Gentiobiose has been synthesized by Helferich, and maltose and lactose by Pictet, the great Swiss chemist, who has recently solved a problem of great difficulty, the synthesis of cane-sugar.

But the ambition of sugar chemists goes still further. They hope to ascertain the complicated structure of the complex polysaccharides which are formed by nature in the colloidal state. Whereas only ten years ago one hardly ventured to discuss the constitution of such substances as starch and cellulose, many are now occupied with the investigation of the chemistry of these bodies. These colloids belong to a class of compounds which are characterized by "large molecules," and they display unusual properties which will have to be studied by new methods and with new chemical conceptions for their explanations. It is also quite recently that we have begun to see light in this field which was formerly so obscure. The opinions in regard to the general chemical behavior of these bodies are quite contradictory as is frequently the case in a new branch of scientific research. A new definition of the term "molecule" or a substitute for it must be found for these complex substances of high molecular weight. The organic chemist usually studies substances that are in the gaseous state or in solution, but here we have to deal with bodies in the solid state. New physical methods must be employed, one of the most promising being the employment of X-ray diagrams which have given us such an insight into the crystalline state of matter. But even along this line the conclusions are not as yet definite. Colloid chemistry has been of aid in the explanation of the behavior of the complex polysaccharides, but the investigators in this branch of science, which has attained great importance during the last decade, are still so occupied in studying the laws which govern simple inorganic colloids, that they have only in exceptional cases concerned themselves with organic compounds. The colloidal studies of Samec on starch are therefore of particular biochemical importance. The history of the chemical investigations of starch has recently appeared in a very attractive book from

the New York Public Library; it contains the complete literature of the subject and gives the present state of the chemistry of the starches as developed by the work of Pictet, Irvine, Karrer, Kuhn, von Euler, Sjöberg, Ling, Sherman and others.

The polysaccharide, cellulose, is at present attracting the greatest interest throughout the world, largely because of its dominating importance in the manufacture of paper and artificial silk. Cotton, which is produced in tremendous quantities in this country, is nearly pure cellulose, but almost all of this is used in the manufacture of cloth. The cellulose that is used in the industries is obtained from wood and the chemistry of this process during recent years has been developed with great success by Klason, Schwalbe and Heuser, by Schorger and Wise, Erich Schmidt and Hägglund. Special laboratories for the study of cellulose and wood have been established in the United States and in Europe, and one in Toronto, of which Hibbert is the director, is just being completed. Special credit should be given to Herzog for the introduction of X-ray methods in the study of cellulose and related substances. These investigations as well as those of Katz, Mark and Sponsler, combined with the chemical studies of Hess, Bergmann, Freudenberg, Irvine and other chemists throughout the world have contributed greatly to a clearer conception of the physical and chemical properties of this most important skeleton substance of plants. In addition to this study of the biologically interesting carbohydrates the investigation of their transmutation by the cell and its enzymes has been greatly advanced during recent years. The finer phases of the decomposition of sugars by alcoholic ferment have been carefully investigated by Harden and Neuberg, who discovered special desmolytic enzymes and cleared up the intermediary stages of alcoholic fermentation as well as numerous bacterial fermentations. It has been shown that the manner in which these bodies are broken down by lower organisms is very closely related to the decomposition of the substances in the animal body, especially in the muscles. To Hill, Meyerhof and Embden is due new insight into the muscular enzymes and into the relationship which exists between the lactic acid and glycogen equilibrium in muscular contraction. Warburg has combined physicochemical methods with biological ones with great success and has ascertained that biological oxidation is related to the iron content of the cell, which he considers to be the essential oxidizing catalyst. On the other hand, Wieland has brought forward the theory that biological oxidation depends upon the activation of hydrogen and not of oxygen atoms. Both theories are supported by very valuable and original experimental work.

The study of the enzymes which split the carbohydrates was made the basis of a most important series of investigations upon enzymes in general by Willstätter and von Euler, who prepared them in a state of purity far surpassing that of earlier products. These new methods for the purification of the biological catalysts were based principally upon their behavior as colloids, and have been applied with equal success to the enzymes which act upon fats, proteins and other substrates. These epoch-making researches of Willstätter were presented by him in April of last year to a Cornell audience in his lectures on "Problems and Methods in Enzyme Research" which he delivered in this room.

Sugars also form a part of the molecule of the pigments which make roses, geraniums, blueberries and other plants attractive to the eye. Willstätter has also cleared up the constitution of these anthocyanins and has shown that they belong to the same chemical group. He has also, with wonderful experimental skill, given us a clearer understanding of the complex molecule which gives the green color to leaves and that is the agent by means of which light energy reduces the carbon dioxide of the air. He has shown that the molecule of chlorophyll is held together by the metallic element magnesium and that magnesium gives to it its reactive properties. Iron plays the same rôle in relation to the red color of the blood. Here again we find that nature forms its most important reagents in closely related chemical structures, since the color of leaves and of blood is due to similar cyclic groups. Willstätter, Piloty, Küster, Schumm, Hans Fischer and others have greatly advanced our knowledge of the constitution of the blood pigment. Their work has enabled Hans Fischer to come close to building it up through his most remarkable syntheses.

We can not leave the field of sugar chemistry without speaking of the discovery of insulin, the hormone of the pancreas which is so essential to the oxidation of sugar in the animal body. The benefit of this great achievement which was accomplished on this continent is enormous, not only in the treatment of diabetes but also as a stimulus to the study of hormones in general, a group of bodies which Professor Barger described in his lectures in this laboratory last term.

The Proteins

The proteins differ in elementary composition from fats and sugars in that they contain nitrogen, and they have always been considered a particularly complicated problem for the chemist. The great variety of changes which they undergo makes it difficult to extract and characterize them. Consequently the earlier investigators in this field in the nineteenth

century devoted their energy chiefly to the purification and classification of the various albuminous substances of animal and plant origin. Only a few of the amino-acids which build up the protein molecule were known in about the year 1900 when Emil Fischer devised new methods for their separation. At about the same time Kossel made a special study of the protamines, a comparatively simple group of proteins which occur in fish eggs, and he discovered how the more complicated amino-acids in them might be separated. Abderhalden in Germany and Osborne in America extended our knowledge of the composition of proteins and Felix Ehrlich discovered a new amino-acid, isoleucine. Ehrlich showed further how fusel oil, the by-product of alcoholic fermentation, is formed by the decomposition of amino-acids. Dakin has recently discovered the nineteenth of the amino-acid constituents of proteins.

Emil Fischer conceived that the amino-acids are combined in long chains in the protein molecule and this led him to attempt a synthesis of protein-like substances termed polypeptides. These bodies resemble in many respects the peptones, the higher degradation products of the proteins, and several of them were found in the hydrolytic products of casein, gelatine and other proteins. The dipeptide, glutathione, which consists of cystine and glutaminic acid, was discovered by Hopkins in most cells. He regards it as playing an important rôle as an acceptor for hydrogen which results in the liberation of oxygen for oxidation processes. The most important characteristic of the synthetic polypeptides of Emil Fischer is that they are hydrolyzed by specific proteolytic enzymes of the digestive tract.

During about the same period our understanding of the metabolism of proteins was very considerably developed. It was shown by Abderhalden that the proteins might be substituted by a mixture of the amino-acids which resulted from the hydrolysis, but only glycocoll can easily be formed from other amino-acids. The others must be present in the food to guarantee the nitrogen equilibrium, without which cell life can exist only a short time. Gelatine, which lacks two amino-acids, trypthophane and tyrosine, can be made a complete protein from the standpoint of nutrition by adding the two amino-acids derived from other sources.

Here again, as in the case of sugar chemistry, a new impetus was given to investigation after the close of the World War. This impetus resulted from the hypothesis that the protein molecule does not consist of peptide chains of great length as Emil Fischer had supposed. In analogy to the new conception that complex polysaccharides are aggregates of small molecular building stones, the suggestion was brought forward that in proteins a similar arrangement should be possible. This theory found some support in X-ray studies which showed a crystalline structure for substances related to a dipeptide anhydride. By rather vigorous reactions, which did not exclude rearrangement, compounds of ring structure were obtained from the proteins. We now know that these views were for the greater part premature, but they have stimulated experimental investigations in a most beneficial manner. A finer analysis of the hydrolytic cleavage of proteins by methods devised by Sörensen, Van Slyke and Willstätter has helped us greatly to reach sounder conclusions.

The greatest progress in protein chemistry has resulted from the application of their specific enzymes. Marked advances in enzyme chemistry have resulted from the observations of Sörensen of Denmark and Michaelis of the Johns Hopkins University, that the hydrogen-ion concentration of the medium must be determined with great exactness. The methods for ascertaining hydrogen-ion concentration and for keeping it constant by the addition of buffer solutions made it possible to determine the optimum acidity point that is a characteristic constant for each enzyme. But the greatest advance in the biochemistry of albuminoids was the first actual separation of the proteolytic enzymes by Willstätter and his coworkers, especially Waldschmidt-Leitz. The pepsin of the stomach can easily be obtained in a state of enzymatic purity, but what had previously been considered to be pure trypsin was shown to be a mixture of that body with erepsin, which was discovered twenty-six years ago by Cohnheim in the intestines. By adsorption methods, trypsin and erepsin were separated and they may now be considered as analytic biological reagents. It had earlier been known that the pancreatic enzyme was accompanied by an activator, enterokinase, but only after their separation had been accomplished was it possible to show that trypsin is an enzyme of quite specific properties, and that it changes into another equally characteristic enzyme after the activator is added to it. Similar results were obtained with the plant enzyme papain, which is activated by hydrocyanic acid. The purification of the proteolytic enzymes such as those of the yeast cell shows that there are several enzymes which exert their optimum activity on substrates of varying structures and of graduated molecular complexity. So here again, as in the case of polysaccharide chemistry, the enzymatic reactions are of great value not only in distinguishing different protein-like substances but also in enabling us to draw conclusions regarding certain groupings of the amino-acids in the protein

molecule. This work which is now being carried on by Waldschmidt-Leitz and other pupils of Willstätter gives promise of great success in this complicated field. The fact that pepsin causes true hydrolytic decomposition and not merely a physical degradation, and that the diketopiperazines, cyclic structures derived from amino-acids, are not attacked by proteolytic enzymes, brings us back to the old conception of the protein molecule consisting of great polypeptide chains. The number of possible linkages by which they might be united is enormous, and we can now only hope for the development of a general theory and not for a detailed knowledge of the structure of the proteins. The study of their colloidal behavior which was inaugurated by Jacques Loeb in this country promises to be of great value in the further development of biochemical research.

From birth to death the life of man is dependent upon biochemical reactions. They take part in the supply and preparation of his food and aid him in its digestion. Cooking and baking, preserving fruit and salting meat, the making of cheese and sour milk, all involve biochemical changes. The process of retting flax and hemp, which are so essential for our clothing, the fermentation of tobacco, which contributes so greatly to the happiness of many, are biochemical reactions. Fermentation processes are involved in the preparation of natural fertilizers, without which an intensive form of agriculture is impossible. Most of the problems of agriculture which have been studied with such great success in the various experimental stations in this country are directly related to biochemistry. The connection between the formation of humus in the soil and the decomposition of its content of micro-organisms, as investigated by Waksman in New Brunswick, is of great interest.

Biochemical principles underlie the purification of our water supply and the destruction of refuse. They enter very largely into the field of medicine and furnish us with many methods for the curing of disease. But great as is their importance, our knowledge in this field is small.

The biochemical reactions of the life processes are extremely complex, and as yet we understand only vaguely the general laws which govern them. We have ascertained many separate and apparently unrelated facts, but we are still unable to make predictions that are based upon mathematical laws. At the present time physical science seems to offer greater attractions to the investigator because of the opportunities that it affords for study of the basic laws of the phenomena of nature.

Nobody can nowadays achieve any great discovery in biochemistry through purely theoretical deduction; important advances can be obtained solely by exhaustive experimental research. And only those heroes of our science who are willing to withdraw their minds from most other interests of human life can hope to accomplish really great results.

Every young student who cherishes the hope of being able at some future time to make a worthy contribution to our knowledge of biochemistry, whether it be of theoretical or practical importance, will have to choose one of two courses that are open to him. He may, and most probably will, follow the general line of development and become a useful but routine chemist, or he may, imbued with higher aspiration, enter upon a road of his own into the dark wilderness of research. His path at the beginning may be strewn with thorns, he may meet with disappointment and discouragement, but in the end he may pick from the tree of knowledge a fruit that is far sweeter than any that he may otherwise have tasted. Let us hope that many of the younger scientists in this audience may be carried forward by their enthusiasm along this road.

HANS PRINGSHEIM

ITHACA, N. Y.

THE THIRTEENTH INTERNATIONAL PHYSIOLOGICAL CONGRESS

THE Thirteenth International Physiological Congress is to be held at the Harvard Medical School in Boston, August 19 to 23, 1929. This, the first meeting of this body to be held in America, promises to be of great interest to American physiologists. It comes just forty years after the first congress met in Basel in 1889. In that the tradition of these congresses was in large part determined by a letter sent out from the office of the Physiological Society in London, as a result of which the first congress convened, it seems appropriate to reprint that letter at this time.

Physiological Society, London.
19th March, 1888.

Sir,

It is suggested that International Meetings of Physiologists should be held at intervals, with the object of promoting the progress of Physiology by the interchange of ideas and mutual friendly criticism, and of affording opportunities to workers in our science of knowing each other personally.

It is proposed to include in the subjects to be brought before such a Meeting only those branches of Anatomy, Histology, Physics and Chemistry which directly bear upon Physiology. With the ample opportunities already existing for the publication of Physiological Papers, it appears unnecessary to provide for printing separately the Transactions of the Meetings. It is intended that all

communications should be as little formal and as fully demonstrative and experimental as possible.

In choosing the place for the first Congress, it has been thought that Switzerland, from its central situation between the most important European States, from the familiarity with it enjoyed by Americans and Englishmen, and from the attractiveness of its scenery, offers the greatest advantages. Should this prove to be the general opinion, we have reason to believe that we should be welcomed in the Swiss capital, where there are ample facilities for meeting and for conducting experimental demonstrations.

The time suggested as most convenient is the end of August, or the beginning of September, in 1889.

We beg leave to commend this proposal to your favourable consideration, and shall feel much obliged if you will kindly communicate to the Honorary Secretary of our Society your views upon the advisability of the plan and upon the place and time proposed. Such meetings can only be made successful by the united help of physiologists in all countries, and it is to ascertain how far we may depend upon your valued co-operation, that we have the honour to address to you this preliminary letter.

We are, Sir,

Your faithful servants,

[Signed] J. Burdon Sanderson (Oxford); Michael Foster (Cambridge); Wm. Rutherford (Edinburgh); J. G. McKendrick (Glasgow); J. M. Purser (Dublin); E. A. Schäfer (London); W. H. Gaskell (Cambridge), Hon. Treas. Physiol. Soc.; Gerald F. Yeo (King's College, London), Hon. Sec. Physiol. Soc.

The plan outlined in this letter was carried out. Those who signed it and many of those who took part in the first and the ensuing congresses are connected with great advances in physiology. Meetings have been held every three years in various European cities. The presidents under whom these gatherings have been held, and the places of assembly, were as follows:

DATE	PLACE	PRESIDENT
1889	Basel	J. Holmgren
1892	Liége	L. Fredericq
1895	Bern	H. Kronecker
1898	Cambridge	Sir Michael Foster
1901	Turin	A. Mosso
1904	Brussels	P. Heger
1907	Heidelberg	A. Kossel
1910	Vienna	S. Exner
1913	Groningen	H. J. Hamburger
1920	Paris	Ch. Richet
1923	Edinburgh	Sir Edward Sharpey Schäfer
1926	Stockholm	J. Johansson

The regularity with which the International Physiological Congress has been held, since its first meeting in 1889, has been interrupted only once. In 1913 the congress met in Groningen, where 443 members were enrolled, representing 19 different nationalities. From 1914 to 1918 the war made these meetings impossible, but in 1920 the French arranged a congress in Paris to which physiologists from allied and neutral nations were invited. At the Edinburgh Congress three years later the Central Powers were well represented, and the original international character of the congress was entirely reestablished at the Stockholm meeting.

Nineteen nationalities were represented at the Paris Congress, twenty-seven at Edinburgh and thirty-three at Stockholm. The number of members of different nationalities reading papers at Paris, Edinburgh and Stockholm may be seen in the accompanying table:

TABLE I

Nationalities	Number of members reading papers Paris 1920	Edinburgh 1923	Stockholm 1926
Argentine	1	—	—
Austrian	—	3	8
Belgian	2	3	8
Canadian	1	7	2
Chinese	—	—	2
Czechoslovakian	—	1	1
Danish	2	—	9
Dutch	11	20	15
Egyptian	1	—	1
English	11	54	20
Esthonian	—	1	—
Finnish	—	—	2
French	39	3	30
Georgian	—	1	—
German	—	18	40
Hungarian	—	—	3
Italian	20	4	4
Japanese	—	1	3
Norwegian	—	—	1
Polish	1	—	8
Portuguese	2	—	—
Rumanian	2	—	3
Russian	—	2	8
Serbian	—	—	1
Spanish	3	—	3
Swedish	5	3	20
Swiss	5	4	1
U. S. A.	8	34	45
Total number of members reading papers	114	159	238
Total number of members enrolled in the Congress	—	408	651

The number of members at each congress has of course always greatly exceeded the number giving papers, but the table has been arranged on the latter basis since this gives a fairer picture of the diverse sources of the scientific contributions. Several na-

tionalities were represented by members who took no active part in the scientific program.

At the last meeting, in Stockholm, the congress unanimously voted to accept the invitation of the American Physiological Society and meet in the United States of America in 1929. The Physiological Society invited the Federation of American Societies for Experimental Biology, with which it is affiliated, to share with it the honor of being host to the international congress. At the meeting of the federation at Rochester in April, 1927, the following committee, representing the constituent societies in the federation, was appointed: Professors John J. Abel, Wade H. Brown, Joseph Erlanger, William H. Howell, Reid Hunt, Graham Lusk, J. J. R. Macleod, Lafayette B. Mendel, Phillip A. Shaffer, Torald Sollman, Donald D. Van Slyke, Alfred S. Warthin and Carl Voegtlin. A subcommittee consisting of Professors Frederic S. Lee, Graham Lusk and Dr. Simon Flexner undertook to raise the necessary funds for the congress.

William H. Howell, of the Johns Hopkins University, was chosen president of the congress, Boston was selected as the place to hold the meeting, and Walter B. Cannon, of Harvard University, was appointed chairman of a bureau to have charge of all arrangements. Drs. Edwin J. Cohn and Alfred C. Redfield were appointed the secretaries of the congress. Membership in the congress will be limited to members of the Federation of American Societies for Experimental Biology and to properly accredited scientists from abroad. Other Americans interested in the physiological sciences may attend the scientific sessions as associate members upon introduction by a member of the federation.

The announcements of the congress have been sent to foreign physiologists who have been members of past international congresses or who are members of learned societies interested in the science of physiology. European interest in the congress has been so great that as early as the Harvey celebration in London last May ways and means of coming to America were discussed by the delegates assembled from different European countries. In this connection, Professor A. V. Hill, of University College, London, has arranged to have 300 reservations held on the *SS. Minnekahda*, sailing from London August 9 and from Boulogne August 10. On this voyage the *Minnekahda* will proceed directly to Boston where she is due on Sunday, August 18, the day before the congress opens.

During the week of the congress, members and their families will be lodged in the dormitories of Harvard University, and members from abroad will be the guests of the Federation of American Societies for Experimental Biology. The scientific sessions of the congress will be held at the Medical School of Harvard University.

Following the scientific sessions in Boston, members from abroad and their families will be given an opportunity to visit the Marine Biological Laboratory at Woods Hole. During the following week arrangements will be made for them to visit scientific institutions and other points of interest in and around New York City. A day's excursion will be made to visit Yale University. Throughout this week the foreign physiologists and their families will live in the dormitories of Columbia University as the guests of the federation. The New York visit will be concluded on Saturday morning, August 31, so that members who so desire may sail for European ports on that day.

In that the International Psychological Congress will be held in New Haven from September 1 to 7, physiologists who are also interested in this congress can readily attend it after the visit to New York.

A week's tour is being arranged for members from abroad who desire to spend a short period of time in travel in America. The party will leave New York on Saturday, August 31, and will go by steamer up the Hudson River to Albany, thence by railway to Niagara Falls and Toronto. After visiting the University of Toronto the party will proceed by boat on Lake Ontario and the St. Lawrence River, passing through the Lachine rapids. The trip will terminate at Montreal. While in Montreal, McGill University will extend certain courtesies to those making the trip. It is expected that members of the party will return to Europe by the St. Lawrence route, or certain of them may prefer to return to New York or visit other places in the United States.

It is hoped that the Boston congress will be signalized by just as free an exchange of scientific ideas between physiologists of different nations as has characterized these meetings in the past, and continue to fulfil the aims voiced by Sir Michael Foster in a letter to Professor Kronecker, "to do our best to make it as informal as possible, so that we may freely and without reserve exchange opinions."

THOMAS CHROWDER CHAMBERLIN—TEACHER, ADMINISTRATOR, GEOLOGIST, PHILOSOPHER

In the passing of Dr. Chamberlin America has lost her greatest geologist and the world one of its boldest thinkers. Since Charles Lyell no one has so greatly changed the fundamental conceptions in earth science. By the force of his intellect he reached unquestioned leadership in philosophical geology, carrying his study of the earth over into celestial physics, and radically

changing the long-accepted theory of the origin and history of the solar system.

Dr. Chamberlin's extended and very successful work as professor, executive and leader in glacial geology has been quite forgotten or overshadowed by the thrilling results of his study in later years. Space here does not allow a fair description of his active life and varied occupation, and the following list of events and dates is a summary.

Born, Mattoon, Ill., September 25, 1843. Died at Chicago, November 15, 1928.

Graduated at Beloit College in 1866.

Principal of Delevan, Wisconsin, High School, 1866–1868.

Married Alma I. Wilson, 1867.

Graduate student at University of Michigan, 1868–1869.

Professor of natural sciences in the Whitewater, Wisconsin, State Normal School, 1869–1873.

Professor of geology in Beloit College, 1873–1882.

Assistant State geologist of Wisconsin, 1873–1876; chief geologist, 1876–1882.

Studied the glaciers of Switzerland in 1878.

In charge of the Glacial Division of the U. S. Geological Survey, 1882–1907.

Professor of geology in Columbian University, 1885–1887.

President, University of Wisconsin, 1887–1892.

Head of the department of geology in the University of Chicago, 1892–1919.

Geologist of the Peary Relief Expedition to Greenland, 1894.

President, Geological Society of America, 1894.

President, Chicago Academy of Sciences, 1898–1914.

President, Illinois Academy of Science, 1907.

President, American Association for the Advancement of Science, 1908.

Research associate, Carnegie Institution of Washington, 1902–1928.

Founded the *Journal of Geology* in 1893, editor-in-chief to 1922, and senior editor, 1922–1928.

Published, "The Geology of Wisconsin," 4 volumes, 1873–1882; with R. D. Salisbury, a treatise on geology in three volumes, 1904–1906; with associates, "The Tidal and Other Problems," 1909; "The Origin of the Earth," 1916; "The Two Solar Families," 1928.

Member of the National Academy of Sciences, the American Academy of Arts and Sciences, the American Philosophical Society and many other scientific societies in this country and abroad.

College degrees: A.B., 1866, and A.M., 1869, from Beloit College; Ph.D., Universities of Michigan and Wisconsin; LL.D., from five universities; D.Sc., Universities of Illinois and Wisconsin.

During thirty years in southern Wisconsin, as student, teacher and geologist, in the region of a splendid display of glacial deposits, it was inevitable that he should become a glacialist. Almost his first papers were three on the "Kettle Moraine," two of them being published in Paris. By the year 1883 he was recognized as the leading American glacialist. Much the larger group of his publications relates to glaciology and the involved branch of climatology. But since about 1900 a large part of his writings relate to solar physics and the geophysical problems involved in a globe of slow growth by infall of cold matter.

Dr. Chamberlin's mind was strongly reflective or philosophic. Except his glacial field-studies and his work for the Wisconsin Survey, few of his writings are largely observational and descriptive. His keen philosophic bent sought for genetic relationships and ultimate causes. The cause of our recent ice-sheets was a sufficiently interesting and difficult problem, but made more difficult and intriguing by the fact of very extensive glaciation in low latitudes of the southern continents, and far back in ancient geologic time; and even more surprising, by the discovery of ice-laid deposits in the most ancient rocks, those of pre-Cambrian time.

The cold climates in most ancient geologic time were positive contradiction of the long-accepted theory of ancient and universal hot climates, as involved in the belief of an original molten globe. This led Dr. Chamberlin in a new quest for the real origin and nature of the terrestrial envelopes, which involved the genesis of the earth itself.

The conception of a molten globe was inevitable under the nebular or Laplacian theory of the solar system. Hence it became necessary to reevaluate the mechanical, physical and mathematical data of the solar family in the light of modern physics and kinetics.

It was a bold and daring adventure to attack a theory of the genesis of the sun and planets which had been universally accepted for more than a century, and was intertexture of all our thinking and almost a part of religion. But Dr. Chamberlin and his associate, Professor F. R. Moulton, in almost a single stroke destroy the old nebular theory. It failed under every test.

It is an interesting illustration of natural conservatism, the hold on thought of long-accepted theory, that with the accumulation in later years of a mass of new principles and exact data in fundamental physics, it should have been left for the geologist to apply the new truth to the origin of the solar system, and to produce a new and acceptable theory.

The astronomers hesitated in accepting the revolutionary conclusion, but to-day if the experts in astronomy do not all accept the planetesimal theory probably no one now holds to the nebular theory. If Dr. Chamberlin's plausible conception is not wholly ap-

proved, and with its geologic implications, certainly the nebular hypothesis is of the past.

Without description of the Chamberlin-Moulton conceptions of the birth of planets and satellites the geologic implications must be briefly considered. Instead of an initial and incandescent globe of full size, surrounded by envelopes of heavy vapors, the planetesimal theory builds the globe by the slow accretion of cold particles (planetesimals). The surface of the slowly growing globe always remained comparatively cold. And when the earth was very much smaller than to-day the physical conditions were similar to those of the present time, with sea and land, storm and sunshine, and perhaps abundant life of lowly forms.

This new theory provides a new foundation, and one much needed, for geologic science. Very few problems in geology can be analyzed without final reference to the origin of the earth, or of its primitive condition. A large part of our geology has been grounded on the conception of a fiery globe, with cooling and solidification of the surface producing the first rocks. In consequence of this universal belief in a once molten earth many problems in geology have remained unsolved and held in suspense. The planetesimal theory greatly helps in the explanation of the fundamental questions in earth science. (See SCIENCE, Vol. 64, pp. 365–371, Oct. 15, 1926.) It is not surprising that some geologists are so committed by their thinking, teaching and writing to the idea of a superheated and liquid earth that they fear cold and solidity. And the new theory was developed west of the Hudson River!

Dr. Chamberlin's work was original and constructive, although to erect his greatest structure he had to destroy an old one. Many of his conclusions in geology are collected in the three-volume treatise, Chamberlin and Salisbury's "Geology," 1904–1906, which remains the most suggestive and authoritative American text-book.

Dr. Chamberlin's absorbing interest in science is shown by his leaving the attractive duties and honors in the presidency of a great state university in order to build a strong department of geology, and have opportunity to devote the years of his maturity to teaching and study.

He was a man of large and handsome physique. With a sensitive nature, he was somewhat reserved and properly dignified, yet urbane and affable. His honors were mostly from the institutions in the area of his life work and from those who knew him best. He was a seer honored in his own country.

The great personal influence of Dr. Chamberlin is perpetuated through the legion of successful and eminent men who found inspiration and training in the great school of geology that he founded and conducted with the efficient assistance of a corps of able associates. Among them were R. D. Salisbury, R. A. F. Penrose, J. P. Iddings, S. W. Williston and Stuart Weller. As time went on, a number of younger men were added to the staff, including his son, R. T. Chamberlin, who keeps the honored name identified with the science of geology.

H. L. FAIRCHILD

UNIVERSITY OF ROCHESTER

SCIENTIFIC EVENTS

THE FIFTH INTERNATIONAL BOTANICAL CONGRESS, CAMBRIDGE, 1930

AT the Fourth International Botanical Congress held at Ithaca, N. Y., in 1926, an invitation from British botanists to hold the next International Botanical Congress in England was accepted. It has since been decided that the Fifth International Congress shall be held at Cambridge from August 16 to 23, 1930, with excursions during the following week.

An executive committee of British botanists has been appointed to make the necessary arrangements for the congress. The members of this executive committee are Dr. F. F. Blackman, Professor V. H. Blackman, Dr. E. J. Butler, Professor Sir John Farmer, Professor F. E. Fritsch, Professor Dame Helen Gwynne-Vaughan, Dr. A. W. Hill, Professor Neilson Jones, Sir David Prain, Dr. A. B. Rendle (treasurer), Professor A. C. Seward (chairman), Professor W. Stiles, Professor A. G. Tansley, together with Mr. F. T. Brooks and Dr. T. F. Chipp (secretaries).

The subscription for membership of the congress will be one pound (£1), which should be paid to the treasurer, Dr. A. B. Rendle, British Museum (Natural History), London, S. W. 7. Early notification to the treasurer of intention to attend the congress is particularly requested.

As at present arranged the congress will be organized in the following sections: Paleobotany, Morphology (including Anatomy), Taxonomy and Nomenclature, Plant Geography and Ecology, Genetics and Cytology, Plant Physiology, Mycology and Plant Pathology.

For each of these sections a British subcommittee has been appointed, by which the program for each section will be arranged. The chairmen of these subcommittees and their addresses are as follows:

PALEOBOTANY: Professor A. C. Seward, Botany School, Cambridge.

MORPHOLOGY (including ANATOMY): Professor F. E. Fritsch, Danesmount, Tower Hill, Dorking, Surrey.

TAXONOMY and NOMENCLATURE: Dr. A. W. Hill, Royal Botanic Gardens, Kew.

PLANT GEOGRAPHY and ECOLOGY: Professor A. G. Tansley, Department of Botany, The University, Oxford.

GENETICS and CYTOLOGY: Professor Sir John Farmer, Imperial College of Science and Technology, London, S.W. 7.

PLANT PHYSIOLOGY: Dr. F. F. Blackman, Botany School, Cambridge.

MYCOLOGY and PLANT PATHOLOGY: Dr. E. J. Butler, Imperial Bureau of Mycology, 17, Kew Green, Kew, Surrey.

As far as possible the program for each section will consist of papers given at the invitation of the sectional subcommittee; arrangements for general discussions will also probably be made by the sectional subcommittees.

THE GORGAS MEMORIAL INSTITUTE OF TROPICAL AND PREVENTIVE MEDICINE

DR. HERBERT CHARLES CLARK, director of laboratories and preventive medicine of the United Fruit Company, has been appointed director of the new Gorgas Memorial Laboratory of the Gorgas Memorial Institute of Tropical and Preventive Medicine, to be established on January 1 in Panama.

The institute has been established by act of congress as a governmental tribute to the public health and sanitation work conducted by the late General William C. Gorgas on the Isthmus of Panama, which made possible the construction of the Panama Canal. Dr. Clark, who spent several years under General Gorgas in the Canal Zone, will carry on research work to make possible a greater economic development of tropical America.

Congress last spring authorized a permanent appropriation of $50,000 a year for the maintenance of the institute. Latin-American governments have been invited to contribute, but it has been stipulated by congress that the total of their contributions should not exceed 75 per cent. of the total contributed by the United States. The participating Latin-American governments are to be represented with the United States on the board of directors. President Coolidge is honorary president of the institute and Rear Admiral Cary T. Grayson is the president.

The republic of Panama has ceded a site for a permanent building for the laboratory, but temporary headquarters will be established in a building newly constructed by that government for a medical school.

Dr. Clark is reported to have made the following statement:

The Gorgas Memorial Laboratory will be an active international coordinating center for research work in diseases which interfere with the economic development of the tropical countries in the Western Hemisphere. Its initial work will be the study of certain phases of malarial control that need development if big corporations from the temperate zone are to go into the tropics.

The greatest loss of labor in the coastal plains of tropical America is from malaria, which is the biggest economic factor among the diseases that belong down there. We expect to study the human carriers of malaria—people who, even after they have been treated and apparently cured, continue to carry the parasites in their seed stages.

We also intend to study the night habits of the mosquitos that feed upon human beings and which do the most in carrying malaria. We need to know more about how far they may go in their flight to lay their eggs.

We shall also work on two special problems in tropical diseases peculiar to Haiti and Colombia. We shall have visitors who will work on special problems, such as a study of various species of monkeys to see whether they carry any malarial or intestinal diseases affecting man.

THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

AT the annual meeting of the Board of Directors of the Long Island Biological Association, held December 4, several matters of general scientific interest were reported. A policy giving primary consideration to research, including its active pursuit throughout the year by means of a permanent staff, has been formally accepted. Steps have already been taken toward carrying the policy into effect with the appointment to the staff of Dr. Hugo Fricke, formerly director of the department of biophysics of the Cleveland Clinic Foundation. The personnel of technicians and assistants has been increased, and equipment for research in biophysics, including work with X-rays and high frequencies, is being installed.

It is planned to receive scientists enjoying sabbatical or other leave from other institutions, who wish to carry on research at the Biological Laboratory at any season of the year. Such workers may apply to the laboratory for financial support during the period of residence, the aim being to aid them to take advantage of the opportunities of a leave of absence without too great financial burden. This plan will apply to American or European scientists wishing to spend part of the year in America, and part of the year in Europe, as well as to those wishing to spend the whole year at the laboratory. Dr. Felix Bernstein, director of the Institut für mathematische Statistik of the University of Göttingen, is the first to take advantage of this opportunity. His residence at the laboratory will begin in February, 1929.

The new policy plans a decrease in the number of students admitted to the biological laboratory at Cold Spring Harbor during the summer. Students in each

course will be expected to carry on research, under the direction of members of the staff, as well as engage in the usual work of the course.

During the fiscal year 1928, the assets of the laboratory have been increased by about $50,000. This includes the new George Lane Nichols Memorial Laboratory.

THE AMERICAN NATURE STUDY SOCIETY

The meeting of the American Nature Study Society, which is to be held in connection with the meeting of the American Association for the Advancement of Science, December 27–31, will have its sessions in the American Museum of Natural History in the Reptile Hall. One of the outstanding features of this meeting will be the fact that the program will cover five days instead of two, as has been the custom heretofore. The five days will be full ones. The New York group will be well represented by speakers who are educators as well as scientists. The nature program from the point of view of the city person, the nature program which is state wide, will be discussed by men and women from many states. The contributions made by various organizations will be discussed by representatives of these organizations. A sight-seeing trip to places of interest around New York to nature leaders will be given on Sunday. Representative nature rooms in the public schools will be opened for inspection to the guests of the society.

Another feature will be the dinner which is to be held at the Hotel McAlpin on the evening of December 28th at 6:30 o'clock. To this dinner have been invited men and women who have made outstanding contribution to nature literature, nature education, nature music and nature painting. A distinguished grand opera singer and voice teacher will sing, and a widely known Japanese poet will chant some of his nature poems in his native language. Mr. William Finley, lecturer and photographer of wild life, will lecture on "Kindred of the Wild."

The president of the society will give the address of welcome on the afternoon of December 27. Liberty Hyde Bailey and Anna Botsford Comstock will speak and messages from some of the pioneer workers in the field of nature education will be read.

At the meeting on December 27–31, at the American Museum of Natural History, there will be a discussion of science teaching in junior and senior high schools and present-day trends in elementary nature teaching. The meetings will be summarized by persons who will be asked to report the following mornings. The contributions made to nature education by various organizations, such as Museums, Botanic Gardens, Zoological Gardens, Children's Laboratories, School Nature Leagues, etc., will be discussed on the morning of December 31.

Bertha Chapman Cady,
President

American Museum
of Natural History,
New York

THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION

Science for November 30 was a special issue containing the full preliminary announcement of the meeting of the American Association for the Advancement of Science and the associated scientific societies, to be held in New York City from December 27 to January 2. It may be well to summarize in the issue of Science that will reach members shortly before the meeting some announcements that it may be desirable to have in mind.

This will be the eighty-fifth meeting of the American Association and the fifth New York meeting. It will be the fourth of the larger convocation week meetings held successively at intervals of four years in Washington, New York and Chicago.

The meeting is under the presidency of Professor Henry Fairfield Osborn, president of the American Museum of Natural History. The retiring president is A. A. Noyes, of the California Institute of Technology. The chairman of the local committee is Professor George B. Pegram, the secretary is Professor Sam Trelease, the honorary chairman is Professor M. I. Pupin, all of Columbia University. The honorary reception committee includes representatives of sixty scientific institutions and societies of New York City.

The main registration headquarters will be in University Hall, Columbia University. Branch registration offices will be maintained at the American Museum of Natural History, the Metropolitan Museum of Art, the United Engineering Societies Building and the American Geographical Society Building.

Railway rates at one fare and a half are obtainable through certificate, which must be secured on purchasing tickets and later validated at the association headquarters.

The hotel headquarters are the Lincoln Hotel, 8th Avenue and 44th Street. The associated societies have various hotel headquarters. Reservations should be made in advance.

The scientific exhibit will be held in University Hall, Columbia University, and will be a continuous conversazione throughout the meeting.

The executive committee of the council will hold its first session at the Hotel Lincoln on Thursday morning at 10 o'clock. The council of the association will hold its first and main session at the Lincoln Hotel at 2 o'clock in the afternoon. The secretaries' conference with dinner will be held at the Hotel McAlpin on Sunday evening. The academy conference will be held late on Thursday afternoon, followed by a dinner.

The opening general reception will be at the American Museum of Natural History on Thursday evening. After President Osborn has taken the chair, and brief addresses of welcome have been made by the mayor of the city and others, an address will be made by Professor Charles P. Berkey, of Columbia University, "On Recent Discoveries in the Geology of Mongolia." There will then be a general reception, the exhibition halls of the museum being open throughout the evening.

Other general sessions with receptions at the American Museum of Natural History will be held through the meeting. On Friday evening the Sigma Xi address will be given by Professor Arthur H. Compton, of the University of Chicago, on "What is Light?"; on Saturday evening an address by Professor William Morton Wheeler on "New Tendencies in Biologic Theory"; on Monday evening the address of the retiring president, Dr. A. A. Noyes, entitled, "The Story of the Elements"; on Tuesday evening an address by Dr. Harlow Shapley, of Harvard University, on "Galaxies of Galaxies."

The trustees of the Metropolitan Museum of Art will give a reception on Sunday evening; the New York Philharmonic Symphony Society will give a complimentary concert on Sunday afternoon; on Sunday excursions are planned to the scientific institutions of the city.

Among general addresses are the sixth annual Josiah Willard Gibbs lecture on Friday afternoon by Professor G. H. Hardy, of the University of Oxford, entitled "An Introduction to the Theory of Numbers." On the same afternoon there will be a showing of the Canti films depicting the growth of cells, by Professor C. A. Kofoid, of the University of California. On Saturday afternoon an address will be given by Professor Franz Boas, of Columbia University, on "Migrations of Asiatic Races and Cultures to North America," and there will be a showing of American Museum films, and a symposium on "Salary Adequacy of Academic Families" under the Committee of One Hundred on Scientific Research. On Tuesday afternoon there will be an address by Professor H. H. Turner, of Oxford University, special representative of the British Association.

The first of the special addresses of the meeting will be on Wednesday evening, the presidential address of Professor Bailey Willis, of Stanford University, before the Geological Society of America, on "The Origin and Growth of Continents." During the week each society will hold not only special programs for its members, but in nearly all cases will also provide addresses and symposia of general interest. Many joint meetings of the sections of the association with one another and with the special societies and of the special societies with one another have been arranged.

Dinners, luncheons and smokers will be held by the special societies and by groups throughout the week.

SCIENTIFIC NOTES AND NEWS

A MEMORIAL meeting in honor of Dr. Hideyo Noguchi was held at the Academy of Medicine, New York City, on the afternoon of December 20. President George E. Vincent, the Rockefeller Foundation, was expected to preside. The speakers announced were: Dr. William H. Welch, the Johns Hopkins University; Dr. Theobald Smith, the Rockefeller Institute, Princeton, N. J.; the Honorable Setsuzo Sawada, Japanese Embassy, and Dr. Simon Flexner, the Rockefeller Institute.

DR. A. D. COLE, professor of physics at the Ohio State University since 1901 and chairman of the department since 1908, died on December 1 at the age of sixty-seven years.

DR. C. S. HUDSON is the recipient of the Willard Gibbs medal of the Chicago Section of the American Chemical Society for the year 1929. Dr. Hudson has been since November 1 professor of chemistry and chief of the division of chemistry of the hygienic laboratory of the U. S. Public Health Service. Previous to that time he was associated with the U. S. Geological Survey, with the Department of Agriculture and for many years with the Bureau of Standards. His fundamental work on the structure of carbohydrates is the basis of the award. The medallist is selected by a jury consisting of chemists from all parts of the United States. Previous recipients have been Svante Arrhenius, of Sweden; Madame Curie, of France, and Sir James C. Irvine, of England. The American medallists have been T. W. Richards, L. H. Baekeland, Ira Remsen, A. A. Noyes, Willis R. Whitney, E. W. Morley, W. M. Burton, W. A. Noyes, F. G. Cottrell, Julius Stieglitz, G. N. Lewis, M. Gomberg, J. J. Abel and W. D. Harkins.

DR. E. C. SULLIVAN, president of the Corning Glass Works, has been awarded the Perkin Medal for distinguished service in applied chemistry, particularly in the development of new types of glassware. The award is made by the Perkin Medal Committee composed of representatives of the American Chemical Society, the American Institute of Chemical Engineers, the Society of Chemical Industry and the American Electrochemical Society.

A WALZ prize in astronomy of the Paris Academy of Sciences has been awarded to Dr. George Van Biesbroeck, of the department of astronomy in the University of Chicago, and to Professor William H. Wright, of the Lick Observatory.

THE third award of the William Wood Gerhard Gold Medal of the Philadelphia Pathological Society was made on December 13 to Dr. F. d'Herelle, who spoke on the "Bacteriophage."

ANNOUNCEMENT of the Chilean Nitrate of Soda Research Awards for Nitrogen investigation was made at the annual banquet of the American Society of

Agronomy. The recipients are Jacob G. Lipman, dean of agriculture at Rutgers University and director of the New Jersey Agricultural Experiment Station; T. L. Lyon, professor of soil technology, Cornell University; Edwin Broun Fred, professor of agricultural bacteriology, University of Wisconsin, and Frank Thomas Shutt, Dominion chemist of Canada. They are the first to share in an annual fund of $5,000 which the Chilean Nitrate of Soda Educational Bureau made available a year ago.

DR. SAMUEL J. HOLMES, professor of zoology, has been named faculty research lecturer for 1929 at the University of California. The faculty research lecturer is selected each year by a faculty committee from among those who have contributed most to science. The committee making the selection is composed of those faculty members who previously have been chosen for this honor.

DR. HERMANN DIEDERICHS, John E. Sweet memorial professor of engineering at Cornell University, has been elected a faculty representative on the board of trustees.

THE General Board of Cambridge University has, on the recommendation of the faculty board of mathematics, conferred the title of Cayley lecturer in mathematics upon A. S. Besicovitch, M.A.

DR. ALIJ IBRAHIM BEY, professor of surgery in the Egyptian University, has been made an honorary fellow of the Royal College of Surgeons, London.

THE national nominating committee of the American Institute of Electrical Engineers has nominated the following for the offices falling vacant August 1, 1929: *President,* Harold B. Smith, professor of electrical engineering, Worcester Polytechnic Institute; *vice-presidents,* Middle Eastern District—E. C. Stone, Duquesne Light Company, Pittsburgh, Pennsylvania; Southern District—W. S. Rodman, professor of electrical engineering, University of Virginia; North Central District—Herbert S. Evans, dean of the college of engineering, University of Colorado; Pacific District—C. E. Fleager, Pacific Telephone and Telegraph Company, San Francisco; Canadian District—C. E. Sisson, Canadian General Electric Company, Ltd., Toronto.

AT the recent meeting of the American Society of Agronomy held in Washington, D. C., the following officers were elected for the ensuing year: *President,* Dean M. J. Funchess, Alabama Polytechnic Institute; *first vice-president,* Professor Clyde McKee, University of Montana; *second vice-president,* Dean W. W. Burr, University of Nebraska; *third vice-president,* Dr. A. B. Beaumont, Massachusetts Agricultural College; *fourth vice-president,* Dr. S. A. Waksman, Agricultural Experiment Station, New Brunswick, New Jersey; *editor,* Professor James D. Luckett, Agricultural Experiment Station, Geneva, New York; *secretary-treasurer,* Dr. P. E. Brown, Iowa State College.

THE newly elected officers of the Rush Society of the University of Pennsylvania are E. B. Krumbhaar, *president;* A. N. Richards, *vice-president;* E. S. Thorpe, Jr., *secretary* and *treasurer.*

DR. J. A. L. WADDELL, of New York, has been retained by the nationalist government of China to act as consulting engineer to its department of railways. He will leave San Francisco on January 4.

CARL O. JOHNS, director of research of the Standard Oil Development Company, with headquarters in New Jersey, has been transferred to the New York office, where he will be in more general touch with the entire research program of the company and will act as vice-chairman of the technical committee.

HAYWOOD M. TAYLOR, chemist for the Fisk Rubber Company, has accepted a position as head of the department of chemistry in the Wilmer Ophthalmological Institute of the Medical School of the Johns Hopkins University.

DR. FRITZ STRIECK, of Professor Grafe's medical clinic in the University of Würzburg, through arrangements with the Notgemeinschaft der Deutschen Wissenschaft and the Rockefeller Foundation, is spending several months at the nutrition laboratory of the Carnegie Institution of Washington in Boston.

S. PLAKIDIS, of the National Observatory, Athens, is spending a year in astronomical study in England. He has spent some months at the Greenwich Observatory and is now assisting in the office of the Nautical Almanac.

RONALD GURNEY, of the Palmer Laboratory of Physics of Princeton University, leaves at the end of this month for Japan, where he has been offered a Japanese research fellowship at the Research Institute of Physics and Chemistry in Tokyo.

EDWARD GUDEMAN, Chicago, has gone to Japan, after which he will make an investigation of the oil and rubber industries in India, spending a month in each of these countries.

L. B. SMITH, of the Gray Herbarium of Harvard University, is devoting five or six months to a field study of the family Bromeliaceae in southern Brazil.

DR. LAFAYETTE B. MENDEL, professor of physiological chemistry in Yale University, addressed the Detroit section of the American Chemical Society on December 12 on "Some Chemical Aspects of Nutri-

tion," and the First District Dental Society of Michigan on December 13, at Detroit, on "Growth and Nutrition." Dr. Mendel also spoke at the Merrill-Palmer School in the same city.

ULICK R. EVANS, of the University of Cambridge, England, will deliver the annual lecture of the institute of metals division of the American Institute of Mining and Metallurgical Engineers during the week of February 18, 1929, in connection with the annual meeting of the institute. Mr. Evans will lecture on corrosion and will preside at the symposium. Following the annual lecture he will deliver groups of lectures in such centers as New Haven, Cambridge, Cleveland, Pittsburgh and Washington, with single lectures at various other points.

PROFESSOR G. H. HARDY, of the University of Oxford, will give a lecture on "Hilbert's Mathematical Logic" at a meeting of the Lehigh Chapter of Sigma Xi on January 8.

DR. LEVADITI, professor of microbiology in the Pasteur Institute, Paris, addressed the students of the University of Pennsylvania Medical School on December 12 on "Neurotropic Ectodermoses."

THE subjects of the lectures of Dr. F. M. Jaeger, of the University of Groningen, Holland, non-resident lecturer at Cornell University during the second half of the academic year, will be "Symmetry and Optical Activity of Atomic Configurations" and "Methods, Results and Problems in High-Temperature Precision Measurements."

WORD has been received by the California Academy of Sciences of the sudden death from angina of W. W. Sargeant on December 4 in Paris. Mr. Sargeant was the secretary of the board of trustees of the California Academy of Sciences from 1913 to 1927, and also of the Pacific Division of the American Association for the Advancement of Science from 1918 to 1927, when he resigned to live in Paris.

THE deaths are announced of Dr. Ernst Wagner, professor of physics at the University of Würzburg, and Dr. Ludwig Klein, professor of botany at Karlsruhe.

THE thirteenth annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held at the University of California at Berkeley, from Wednesday to Saturday, June 19 to 22, 1929. Following is a partial list of scientific societies which are likely to participate in the sessions: The American Mathematical Society, the American Physical Society, the American Meteorological Society, the American Chemical Society, the Astronomical Society of the Pacific, the American Association of Economic Entomologists, the Ecological Society of America, the Western Society of Naturalists, the Society for Experimental Biology and Medicine, the American Phytopathological Society, the Botanical Society of America and the Western Society of Soil Science. It is hoped that a considerable number of scientists living outside the territory of the Pacific Division will find it possible to attend. The printed announcement of the meeting will be distributed late in March to all members of the Pacific Division. Any other member of the American Association for the Advancement of Science may receive a copy of the announcement by sending a request to the secretary, A. G. Vestal, Stanford University, California.

THOMAS A. EDISON spoke on December 15 by radio from his Menlo Park laboratory, formally dedicating a tablet marking the shops which he first occupied in Schenectady, forty-two years ago. These shops have since witnessed the growth of a vast manufacturing plant of 350 buildings on a 650-acre plot, the present Schenectady works of the General Electric Company. Mr. Edison was introduced by Mr. Edwin W. Rice, Jr., honorary chairman of the board of directors of the General Electric Company. Mr. Edison's assistant, William H. Meadowcroft, spoke at the exercises. The tablet, which was unveiled by Mr. George F. Morrison, vice-president of the General Electric Company, himself an Edison pioneer, reads: "In this building, and in the building at the right, Thomas A. Edison established the Edison Machine Works in the year 1886. From this small beginning grew the Schenectady works of the General Electric Company. This tablet erected in 1928."

RADIO advices from the non-magnetic yacht *Carnegie*, which left Balboa, Canal Zone, October 25, for the first passage in the Pacific of her Cruise VII, state she arrived at Easter Island December 6, four days ahead of her schedule, with all well on board and after a fine trip with ideal weather conditions and no storms. The observational work during the passage from Balboa to Easter Island included 58 magnetic stations, 10 ocean and tow-net stations, 70 sonic depth-determinations, 24 pilot-balloon flights, 6 evaporation series, 23 biological stations, 25 days of photographic records of atmospheric-electric potential-gradient, and four 24-hour runs of other atmospheric-electric elements. Because of a slight leak which developed in the depth-finder oscillator (mounted on the keel of the vessel), echoes for soundings have been obtained through firing of a shotgun at the end of a pipe extending 20 feet below the surface; the results with this emergency arrangement have checked out well with depths determined by wire and pressure.

Captain Ault expects to leave about December 14 for Callao, Peru, where the vessel is due early in January.

IN cooperation with the Tropical Plant Research Foundation, the Charles Lathrop Pack Forestry Trust has undertaken a three-year field survey of Latin-America. This survey has two aims, to learn by exploration the extent of tropical America's commercial forest area and to learn by laboratory and factory test the purposes for which the most abundant woods are best fitted. For the next two years the survey will devote itself to the forests of Central America and southern Mexico. The last year will be devoted to the greatest storehouse of all tropical timber—the valley of the Amazon. If time permits, explorations will be extended to that little known country, the western coast of South America.

ACCORDING to press reports, Dr. J. Tozzi Calvao, of Brazil, has abandoned his plans to explore the jungles of the Aripuna River, having failed to secure financial support from the Brazilian government. Tentative arrangements had been made to turn the expedition over to Dr. Norman Taylor, of the Brooklyn Botanic Garden, who had joined the expedition as botanist, but Dr. Calvao later refused to release the equipment which he had gathered for the trip.

THE faculty of medicine of Harvard University offers the regular course of free public lectures on medical subjects, Sunday afternoons, beginning on January 6 and ending April 14. The lectures will begin at four and the doors will be closed at five minutes past the hour. No tickets are required.

Jan. 6—Bishop Lawrence, "Social Infection and the Community."
Jan. 13—Dr. C. E. Turer, "The School Health Program."
Jan. 20—Dr. J. P. O'Hare, "Chronic Bright's Disease and High Blood Pressure."
Jan. 27—Dr. W. B. Cannon, "Natural Defenses of the Body."
Feb. 3—Dr. John Homans, "Varicose Veins and Varicose Ulcers."
Feb. 10—Dr. E. A. Locke, "Pulmonary Tuberculosis."
Feb. 17—Dr. W. L. Aycock, "Infantile Paralysis."
Feb. 24—Dr. Shields Warren, "Cancer and New Growths."
Mar. 3—Dr. L. W. Baker, "The Deformed Mouth of a Child: Its Effect on the Child's Future."
Mar. 10—Dr. Reginald Fitz, "Health Problems of the Modern Boy and Girl."
Mar. 17—Dr. Marshall Hertig, "The Warfare between Man and Insects."
Mar. 24—Dr. W. H. Robey, "Old Age."
Mar. 31—Dr. F. W. Palfrey, "Diagnosis: Or Determining What is the Matter."
Apr. 7—Dr. Soma Weiss, "Drug Addiction and Its Consequences."
Apr. 14—Dr. C. G. Lane, "Skin Diseases of Occupational Origin."

UNIVERSITY AND EDUCATIONAL NOTES

JULIUS ROSENWALD has given to the University of Chicago the sum of $1,200,000 for the building of dormitories. This gift will be increased to $2,000,000 if the university can raise an additional $3,000,000. The plans call for the erection of dormitories for 400 men and 380 women on unoccupied university ground.

A CHAIR of agriculture, endowed in the sum of $125,000, has been provided for the University of California by the will of the late Jessie D. Carr Seale. The will also bequeaths $40,000 for the endowment of five scholarships in the university. The chair is to be known as the Jesse D. Carr agricultural chair, as a memorial to Jesse D. Carr, of Salinas, the father of Mrs. Seale. In addition, whatever residue remains in the estate after the other bequests are cared for will go to the chair's endowment.

A GIFT of $250,000 toward the endowment fund of $2,000,000 has been made by Edward S. Harkness, of New York City, to the Albany Medical College.

THE research laboratory of the Cleveland Clinic, a building eight stories high, founded by Dr. George W. Crile on his retirement as head of the department of surgery of Western Reserve University, was dedicated on December 15.

CHARLES HAROLD BERRY has been appointed professor of mechanical engineering at Harvard University to succeed Professor Harvey N. Davis, who has resigned and accepted the presidency of Stevens Institute.

AT Columbia University, Dr. Hans T. Clarke, of the Eastman Kodak Company, has been appointed professor of biological chemistry; Arthur W. Hixon has been promoted to a professorship of chemical engineering; Dr. Goodwin L. Foster, of the University of California, has been appointed associate professor of biological chemistry, and Edmund W. Sinnott, of the Connecticut Agriculture College, professor of botany. Harold Clayton Urey was approved as associate professor of chemistry; Edward Settle Godfrey will be clinical professor of epidemiology. The resignation of J. Clayton Sharp, associate professor of anatomy and histology, will take place next June. Harold M. Terrill, associate in physics, received an extension of his leave of absence.

AT the University of Texas, Mr. F. B. Plummer has accepted appointment as geologist in the Bureau of Economic Geology. Dr. J. T. Lonsdale, formerly geologist, has resigned to become professor of geology and head of the department in the Texas Agricultural and Mechanical College. He retains, however, connec-

tion with the Bureau of Economic Geology as consulting geologist.

DR. KARL FRIEDERICHS, professor of applied entomology in the University of Rostock, has been called to the University of Minnesota.

DISCUSSION AND CORRESPONDENCE

THE MEANING OF VITAMIN A

A RECENT discussion in these columns of the nomenclature of the "accessory food factors" commonly called vitamins[1] suggests for these substances a new set of provisional names, each to be distinguished by a prefix "in accordance with the disease for which it is preventive." Strongly as we sympathize with the desire to prevent further confusion, we are unable to believe that that laudable purpose would be advanced by this suggestion. The vitamins, while not yet chemically identified, are apprehended as chemical individuals to each of which in due time will presumably be assigned a name descriptive of its chemical nature. Meantime the nutritional significances of these substances are being studied, and as the knowledge of each has separately been advanced by experimental investigation, increasing emphasis has been laid upon its rôle in normal nutrition. In dealing with substances which are presumably chemical individuals and are certainly essential nutrients, it seems distinctly preferable to avoid or minimize the use of designations characterized by what the British Committee has aptly called "pharmacological bias."

The alphabetical designations of the vitamins, while admittedly colorless, have the very great advantages of freedom from such bias and from connotations inconsistent with anything which may be learned by further study of these substances. Under the noncommittal designation of a mere letter, our knowledge of any vitamin may grow in any direction without the development of inconsistency between the designation of the substance and its more newly discovered properties, and without the development of a situation in which the name would appear to put the emphasis in the wrong place. Without further elaboration in general terms, this may be illustrated by the case of vitamin A.

Vitamin A is a normal nutrient. It is essential to growth in the young; and it is essential to normal nutrition and health at all ages. Lack of vitamin A results in a widespread weakening of the tissues of the body and of its ability to resist infections. An early and frequent manifestation has been the development of an ophthalmia. This has occurred so regularly (at least in the experience of most observers) as to be rightly regarded as a fairly characteristic result of a lack of vitamin A. But it is only one of several results, and probably not the most important; for further studies have shown that the same nutritional deficiency which gives rise to the increased susceptibility to this eye trouble results also in an increased incidence of respiratory disease (probably a matter of greater actual significance, even if less readily adapted to experimental demonstration); of skin, ear and sinus infections; of inflammations and infections of the alimentary tract; and even of renal calculi. That like deficiencies of vitamin A in the food are not always followed by like effects is largely due to the important degree to which this substance may be stored in the body; and this in turn again emphasizes its rôle as a normal nutrient. Thus in a recent series of experiments young rats were taken at the same age from families of the same hereditary stock but which had been fed on different diets, one richer than the other in vitamin A but both within the range of the normal in this as in other respects. All were then subjected to the same experimental régime involving first a period of deprivation of vitamin A until the body no longer contained a surplus store of this nutrient and then a longer period during which only a fixed limited allowance was fed. Afterward all were killed and examined for plain evidence of infection. Notwithstanding the relatively long period during which all had received the same diet, it was found that resistance to infection was still greatly superior among those which in their very early lives had received the more liberal allowance of vitamin A. Taking account of the relative lengths of the rat and the human life cycles, and the similarity of nutrition in the two species, this is an indication of the differences of incidence of infection to be expected among children of around ten and twelve years, resulting from differences in the way they were fed before they were three years old. In terms of articles of food, it was a higher proportion of milk in the diet which here conferred the higher degree of health as manifested by increased ability to resist disease; and in chemical terms, vitamin A was one of the significant factors. The significance of vitamin A for general health and stamina has also been clearly shown in other ways. Experimental animals alike in all other respects and fed different allowances of vitamin A may show differences either early or late according to the extent of the dietary deficiency and the differing opportunities which had been afforded the animals to acquire a bodily store in advance of the period of dietary deprivation. But even when the differing dietary allowance of vitamin A did not produce obvious effects

[1] Robert L. Jones, "Nomenclature of the Accessory Food Factors," SCIENCE, 68: 480, 1928.

during the period of growth, the effects upon later life were very pronounced and showed that a liberal intake of vitamin A has a most important bearing upon the length of life and upon the general stamina of the adult as reflected in ability to resist disease and to produce and rear healthy offspring.

Thus our growing knowledge of vitamin A gives it a meaning very much broader than merely that of a substance which prevents an eye disease. While the relation to ophthalmia is well worth remembering, yet there now seems certainly to be a still greater significance in the effects of vitamin A in increasing resistance to respiratory disease and in contributing to the condition of general health and vigor, both in the individual and in successive generations.

To suggest the habitual use of any such term as "antiophthalmic vitamin" or "ophthalamin" seems, therefore, probably to put the emphasis in the wrong place, and certainly to be unfortunate in that it diverts attention to but a small part of the true meaning of vitamin A.

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THE SIEVE OF ERATOSTHENES

IN SCIENCE for September 21 (p. 273) a writer directs attention to the alleged "widespread error" of attributing to Eratosthenes the "sieve" for finding all the prime numbers which do not exceed a given number. The writer claims that the method was known long before the time of Eratosthenes, but does not state on what evidence his statement rests. He simply gives the information as a well-established fact and directs the reader to E. Hoppe's "Mathematik und Astronomie," 1911, p. 284. Consulting Hoppe one meets with the statement that the method is found in Plato's "Phaedo," chap. 52, and that Plato also proved the number of primes to be infinite, a proof usually ascribed to Euclid. *If true,* these statements are important and deserve to be published in a widely read periodical like SCIENCE. But are they true?

Hoppe's statement has not been fully accepted by any historian of mathematics. Plato in "Phaedo" speaks of hot and cold, fire and snow, as necessarily excluding each other. Likewise the idea of odd and the idea of three and of five are opposite to the idea of even and of two. They reciprocally exclude each other, as indeed do the immortal soul and death. This is not the place for extensive quotation from Plato. It is sufficient to say that it is not clear that Plato considers here prime numbers at all, as a class. The late G. Eneström, the very ablest recent critic in the field of mathematical history, printed in his journal a review by G. Junge who expresses himself on this matter as follows ("Bibliotheca mathematica," XII, 1911–1912, p. 356): "Mr. Hoppe is not at his best when he purports to discover in Plato's writings all sorts of mathematical results which no one before him has yet found in them and which probably no one will find in them again. Thus he claims (p. 284) that the sieve method of Eratosthenes is 'already fully developed by Plato' and that the theorem that the number of primes is infinite is found in Plato." No further comment on our part is necessary.

FLORIAN CAJORI

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THE PROBABLE USEFULNESS OF BLOOD-GROUPING TESTS IN ESTABLISHING NON-PATERNITY

IN connection with bastardy proceedings it is desirable that the defendant may know the chances of establishing his innocence by comparing his isohemagglutination group with that of the mother and of the alleged offspring.

We have calculated the probabilities which obtain among the white population of the United States. Details of the method will shortly be published elsewhere. The results, based upon the inheritance hypothesis of Bernstein, are as follows:

PROBABILITIES OF ESTABLISHING NON-PATERNITY WHEN ONLY THE WRONGFULLY ACCUSED MAN'S BLOOD GROUP IS KNOWN

	Group		Probabilities
Landsteiner	Jansky	Moss	
0	1	4	1/5
A	2	2	1/17
B	3	3	1/7
AB	4	1	1/2
Unknown			1/7

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PRESSURE PHENOMENA IN THE DIVIDING CELL

MOTION photography reveals phenomena which do not register upon the physiological eye. Just as the microscope alters space dimensions, so may the motion camera accommodate time dimensions to a scale of normal interpretation, and thereby draw closer the relation of morphology to physiology. Evidence has, for example, been obtained by this instrument, which demonstrates the existence of defi-

nite protoplasmic pressure fluctuations during the process of cell division.

A film portraying the life cycle of the oyster contains a stop motion scene illustrating the first stages of cell division. A minute perforation in the cell wall of the egg permitted some of the protoplasm to protrude. Ordinarily such a punctured egg would not attract attention, and this one would have been discarded had it been detected in time. The camera, however, went on recording the remarkable behavior of this indicator of what development of the print revealed to be unmistakable pressure pulsations.

The gradual change in form at the moment of cell division unnoticeable to the eye becomes in the accommodated time of the film a vigorous squirming of escaping protoplasm, indicating a marked internal pressure. A more astonishing effect immediately follows the completion of cell division, when as though by violent suction the protoplasm disappears again within the cell wall. The phenomenon is repeated at each succeeding active phase of cell division, though gradually weakening until obscured by the progressive disintegration.

A more detailed illustrated description is being prepared and arrangements are being made to show the film at the New York meeting of the American Association for the Advancement of Science.

WM. FIRTH WELLS

HAIRY MAMMOTH SKELETON IN UTAH

GRAVEL workers at the gravel pits two and one half miles east of Payson, Utah, on September 17, uncovered a partial skeleton of what appears to be an ancient hairy mammoth (*Elephas primigenius*). Excavations were immediately placed under the supervision of the author, and have resulted in the recovering of two well-preserved spirally curved tusks, two teeth, two legs with feet intact, a lower jaw bone and a number of rib bones.

The left tusk is six feet long, outside measurement, and three feet nine inches measured from tip to base, fourteen inches in circumference and ends with a sharp tip. The right tusk is five feet five inches long, outside measurement, and three feet four inches from base to tip, fourteen inches in circumference at base and six inches at tip.

The right tusk has been worn off farther than the left, perhaps because of its use in digging through life. Present-day African elephants almost invariably have their right tusk worn down shorter than the left by their industrious digging.

The teeth are moderate in size, one being found intact in the lower jaw, which is perfect in form, has fourteen well-developed dental plates, thin and fine in texture, placed at a moderate distance apart and firmly cemented together. The other tooth is an upper, reasonably well preserved but lacking in completeness.

A complete skeleton was not to be found, which of course is the usual case with finds of this sort where the individuals are entrapped in terrace gravels or delta deposits. The parts recovered were enclosed in a thin bed of fine clay fifteen feet below the surface of the terrace gravels of what is termed the Provo stage of the ancient Lake Bonneville. The parts of the skeleton that projected either into the almost blood-red gravels above or the coarse grain sands below the shale suffered complete oxidation and were not to be found.

Geologically this find is of late Pleistocene in age (estimated thirty thousand years), and locally dates back to a time when Lake Bonneville covered the greater part of western Utah to a depth of perhaps one thousand feet in places.

This represents the second find to be made near the town of Payson during the past few weeks. On September 7, the hind leg of another individual (measuring six and one half feet) was obtained at a gravel pit two miles to the west.

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QUOTATIONS

INTERNATIONAL CONGRESSES[1]

(ABSTRACT of a paper by Dr. J. E. Baron de Vos van Steenwijk, in the *Haagsch Maandblad,* translated for the announcement of the Fourth Pacific Science Congress to be held in Java in May, 1929.)

Opinions concerning the use of congresses are widely divided. The reason for this seems to be that their use is not general, but personal, *i.e.,* that not science itself reaps so much benefit, but rather the scientists themselves who attend the congress and come in personal contact with colleagues from afar. It is true that not every one is able to assimilate all the good that can accrue from such meetings; some people are quite at ease in the turmoil of a congress while others do not feel at home and remain unsatisfied. The latter are afterwards apt to criticize sharply.

In my opinion the success of a congress can not be judged by the apparent results; and certainly not by the motions and resolutions that have been passed by it but which never come into force. At a congress to be attended by several hundred persons, good work

[1] Copied with kind permission of the editorial staff of the *H. M.*

can only be done if a permanent committee has carefully prepared the program, and later on sees to it that the resolutions passed thereat are acted upon. The latter part is, however, it seems to me, not the task of a congress, but rather the work of associations and societies.

Scientific addresses are the main point at a congress; and if certain delegates state, even if they only do so privately, that meeting their colleagues is the only important function, that the reading of papers is only of secondary importance, then I hold the opinion that there is "something rotten" in the world of congresses. An explanation of such a point of view is, however, easily found. The congress committee itself should prepare a list of the scientific subjects to be discussed, so that a whole is formed of which different parts are in harmony with each other; and moreover it should invite those scientists who have made a special study of such subjects to send in a contribution. Instead of this, owing to the casual acceptance of every speaker who comes forward, a succession of heterogeneous and indigestible dishes is at present generally served. It is a good thing that no statistics have been established showing the number of listeners who have understood, or better still, who have quite enjoyed a lecture; the figures obtained would, I fear, bring a blush of shame, not on the faces of the hearers, but on those of the speakers. He who speaks on any subject before his colleagues, although they may not have specialized in such a subject, and can not make his thesis perfectly clear to them all, be it that the subject lectured upon was unsuitable or that it was badly presented, then, I maintain that such a lecturer should not be allowed to address a congress.

An important object of a congress should be the promotion of synthesis, which is more and more a necessity in the world of science of our day, now that nearly every one must perforce confine himself to his own specialty. Series of papers on one and the same problem, seen from different points of view, are also very useful. The impression made on me by a series of papers on the structure of the atom, read at a recent congress, was much more powerful and lasting than that of any single paper which I have heard since; I attribute this to the multiplicity of the subjects treated, which clash in our memory and so lead to meager results. One sometimes gets the impression that a particular item of specialized research, which is of interest actually to only a small group of specialists, is nevertheless considered suitable for discussion at a congress. The wide scope of a congress is not, however, necessary to reach that small group. The subjects worthy of attention at such an important meeting as a congress are those, the results of which, although obtained by work in a special line, are a valuable asset to much wider ranges of thought and deserve to be brought to the attention of the many who might otherwise never have had access to them. Suitable subjects also are those on the border line of different branches of sciences, and finally reviews which present a summary of the present state of our knowledge on a special question.

Of particular interest are controversial subjects which should lead to interesting discussions. But generally, owing to the organization of the meetings, there is not sufficient time for the discussion and it is necessary to close it just when interest has reached its highest point. The most satisfactory method is to have the lecture printed and distributed before the meeting, so that every one may be supposed to know all about it; the arguments of the lecturer should be clear and concise and the discussion opened by some one previously invited to do so. The main point is the principle that only speakers are allowed who have been invited to do so, and who speak on subjects as arranged with the committee. This allows a restriction of the number of papers to be read, which otherwise would grow to such an alarming size that "Multum non multa" is lost sight of.

But looking after the scientific program should not be the only task of the officials of the congress; they should also facilitate so far as possible personal meetings between members. The first essential for this is that members should be able to find each other without having previously met. At many congresses, unfortunately not always, a list with the name of every member is available and every one is invited to display his number and badge. To have the name and address calligraphed on the badge is still better: it saves many painful moments of uncertainty to those unable to remember a face. It is the custom, at the first session of certain congresses, for every member to rise for a moment and to call his name and address. I have also seen a blackboard, placed in one of the principal halls, upon which each scientist could write the name of those whom he desired to meet, for instance, no. 15 will be pleased to meet no. 47, etc.

Receptions, excursions, etc., are also useful as occasions for private conversations from which much benefit may accrue. Such are impossible, however, when circulation is impeded, as during a concert or a long motor trip. This brings to my mind a remark about which there will be no disagreement, that the members of a congress should not be obliged to waste much of their costly time—costly in many ways, when having just made a long voyage—to listen to many compliments or participate in useless ceremonies. If, at the opening session, after the welcome by the Minister and by the City and County Councils, many other dele-

gates from associations rise to speak, one may well complain of the length of the road to be covered before attaining the Promised Land. Even at the inaugural meeting, when all protocol can not be avoided, the presidential address should not be buried under a mass of others. The way followed at a certain congress, where representatives of foreign countries, upon their names being called, simply came one by one to the podium to shake hands with the president, making thus "acte de présence," seems to me an easy and correct arrangement.

SCIENTIFIC BOOKS

Destructive and Useful Insects; Their Habits and Control. By C. L. METCALF, M.A., D.Sc., and W. P. FLINT, B.S. McGraw-Hill Book Co., Inc., New York (1928). xii + 918 pp., 561 text illus.

IT is impossible to do justice to this big book in a short review. I marvel at the confidence of the authors in starting such a comprehensive work almost as much as I marvel at their achievement in completing it. It contains in its nine hundred pages enough material for several books; and the student who uses it in his introductory courses will find it a standby in later life in helping to solve his insect problems. It takes the place, in a way, of a small entomological library. Of course, no one man could have done it so well. Dr. Metcalf, a sound research man with fifteen years of teaching experience, and Mr. Flint, with his record of twenty-five years of successful work in agricultural entomology, make a strong combination. And how they must have worked!

The first eight of the twenty-three chapters are concerned with insects as organisms, aside from the general consideration, in Chapters I and II, of these creatures as enemies of man and as of value to man. "External Morphology," "Internal Anatomy and Physiology," "Mouth Parts," "Development and Metamorphosis," "The Place of Insects in the Animal Kingdom" and "Orders of Insects" are the headings of comprehensive chapters. Insect control is given general consideration; a chapter is devoted to apparatus for applying insecticides, and the remaining chapters consider insects in relation to the different crops, the final ones treating of insects attacking shade trees and shrubs, greenhouse insects, household insects and stored product insects, species injurious to domestic animals and insects that attack and annoy man and affect his health.

That seems pretty well to cover the whole field, does it not? Of course, the forester will notice that forest insects are omitted; but the authors evidently had the choice of omitting them or of giving them scanty consideration. And it seems to me that their decision was wise.

A laudable feature of the book is the introduction of frequent "tables, synopses, and outlines" which are great aids; and under the different crops or cultures the field keys for the identification of the insect pests of each particular crop are very convenient. In fact, with the aid of these field keys, a farmer or fruitgrower will be able to identify any of the more important crop pests that occur in this country.

When we think of the very great number of topics considered in this big book, its balance is remarkable. The especial interests of the reader will undoubtedly cause him to regret that more extended treatment is not given to one or another topic, but when he considers the work as a whole he can not but admire the good judgment of the authors in this matter of balance. It is in this way that I console myself for the very brief consideration of the insect parasites of injurious insects. Perhaps, on account of my especial interest, I may overestimate the value of this element of natural control; but even so it seems that a little more space should have been given to it.

The book seems to be absolutely up to date. The authors are very familiar with the enormous literature, and have made admirable use of this knowledge. They have printed no separate bibliography, but a mere bibliographical list would obviously have filled so many pages as to make its publication impracticable. There are publication references here and there, usually in a few lines of small type after each of the more important topics, and I am not sure that this is not the best way.

The illustrations as a whole are admirable. They have been well selected, and some of them are original. In the crediting of the sources of some of these illustrations mistakes have been made, but that sort of thing has gone so far now in entomological books (as well as in other books) that it seems impossible to correct it; and at all events it means little except to the man who prepared the original illustration.

In preparing a review of a big book one feels that he should write a big review. But a brief one suffices when practically everything that is to be said is of a laudatory character, and this is the case with this review of a remarkably fine book.

It is most appropriate that the authors should have dedicated their work to Professor S. A. Forbes, "Dean of American Economic Entomologists," and to Professor Herbert Osborn, "Master Teacher of Entomologists."

Both authors and publishers are to be congratulated on the "get-up" of the volume.

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REPORTS

THE SMITHSONIAN INSTITUTION

Nearly a million specimens were added to the scientific collections administered by the Smithsonian Institution during the fiscal year ending July 1, according to the report made by Secretary C. G. Abbot to the Board of Regents at their annual meeting on December 13.

From Alaska, the Dominican Republic, the American southwest and elsewhere came objects made by prehistoric man; from the Philippines came the C. F. Baker collection of East Indian insects, one of the finest in existence; from Honduras, Formosa and Sumatra came plant specimens; from Siam and China, valuable natural history collections; from Mexico and elsewhere, rare and important minerals.

These large additions to the scientific resources of the institution in one year serve to emphasize the major point made by Dr. Abbot in his report, namely, that the Smithsonian is first of all a research institution, and that one of its first responsibilities is to study these collections and give to the world the knowledge gained from them. He points out that what visitors see in the National Museum where these collections are housed is but a fraction of its wealth. The study collections include millions of specimens never put on exhibition, but which provide the basic material for studying the fauna, flora, geology, paleontology and ethnology of our country and other areas of the earth. Extensive researches of scientific value, and not infrequently of immediate utility, are constantly being based on this material.

Therefore, while recognizing the importance of the Smithsonian and its branches as centers of interest to visitors, Dr. Abbot defines the principal activities of the institution as the collection of new specimens before the constantly changing face of the earth renders this impossible; the study of existing national collections; the promotion of researches growing out of expert knowledge of the Smithsonian, for example, in the field of radiation; the publication of knowledge in both technical and popular forms, and the wide diffusion of knowledge through exchanges and correspondence. "Only one thing is lacking to promote these objects," said Dr. Abbot. "We have the equipment, the experts, but we lack the means."

In pursuance of these purposes during the last year the Smithsonian and its branches sent out 30 expeditions relating to the natural history sciences, working in fields as far apart as Alaska, Mexico, South America, South Africa, China and the East Indies. Special attention was paid to the West Indian archipelago where zoological, paleontological and archeological expeditions were sent by the National Museum. These expeditions were largely financed by small grants from interested friends of the institution.

Under Dr. Abbot the institution is expanding its researches in the physical sciences. The Astrophysical Observatory continued reduction of the measurements of solar radiation from the institution's observatories in Chili, South Africa and California. The growing mass of data will in time enable the institution to determine whether there is any periodicity in solar radiation and whether it will be possible to forecast weather for long periods ahead on the basis of this periodicity.

Cooperating with the New York Commission on Ventilation, the institution has determined what the cooling of the human body by radiation and convection is, fundamental data for the determination of proper ventilation for school and assembly rooms. In cooperation with the Fixed Nitrogen Laboratory, research has been started on relations of radiation to plant growth and on the measurement of certain ultra-violet rays. This is being made possible largely through a grant of $15,000 from the Research Corporation of New York.

The record of publications for the year is 117 volumes and pamphlets, of which there were distributed altogether 183,198 copies. The International Exchange service, which was organized by Secretary Henry in 1850, sent abroad to 54 countries a total of 486,789 packages of scientific and governmental publications and received for distribution in this country 55,434 packages.

Among the activities reported by the Bureau of American Ethnology for the year were the studies made by Mr. J. P. Harrington among the Santa Barbara Indians of California. For the first time the history of Alta, California, from the Indian viewpoint, was studied, throwing much light on hitherto dark chapters. Among other things these studies proved that Cabrillo was the discoverer of Monterey.

The International Catalogue of Scientific Literature continues to catalogue American scientific publications, though the public is largely deprived of the benefits of this work through lack of means for publication.

Eighty-seven donors, including President Coolidge, presented to the National Zoological Park during the year 138 specimens. Among these were a shoebill stork and two red birds of paradise from the Walter P. Chrysler fund.

The Smithsonian Library notes two important gifts during the year: the Chinese Library of the late Honorable William Woodville Rockhill, traveler, scholar and U. S. minister to China, and 3,500 volumes of serial and society publications, many of which are out

of print, from the American Association for the Advancement of Science.

The National Gallery of Art is unable to record much progress for the year due to the lack of a building for the exhibition of material, other than the small space available to it in the Natural History Building. The outstanding gift of the year was the Thomas Moran painting of the Grand Canyon of the Yellowstone, presented by Mr. George Dupont Pratt.

SPECIAL ARTICLES

THE SHAPE OF CORK CELLS: A SIMPLE DEMONSTRATION THAT THEY ARE TETRAKAIDECAHEDRAL

In SCIENCE, June 18, 1926 (pp. 607–609), the author reviewed his papers which seem to show conclusively that cells in masses are typically tetrakaidecahedral—a shape significant since Lord Kelvin had found that tetrakaidecahedra solve the problem of dividing space, without interstices, into uniform bodies of minimal surface. Lord Kelvin's mathematics was called in question in SCIENCE, September 3, 1926 (pp. 225–226), and, as expected, was promptly vindicated (Matzke, *Bull. Torrey Bot. Club*, 1927, 54: 341–348; Gross, SCIENCE, August 5, 1927, 66: 131–132). But that massed cells are tetrakaidecahedral seems to have found no general recognition since its announcement in 1923, based then on the forms in elder pith only. Accordingly an inescapable and extremely simple demonstration that a cork cell, on the average, makes fourteen contacts with the cells which surround it, is here presented.

A tangential section of commercial cork shows that the cells when cut in that plane are, as an average, hexagonal. But when these cells are cut lengthwise, which happens when cork is sectioned either radially or transversely in relation with the tree-trunk, then—in the words of Hooke's "Micrographia"—the cells or pores are seen to be "not very deep, but consist of a great many little boxes separated out of one continued long pore by certain diaphragms." Thus eight surfaces are accounted for—an inner and an outer diaphragm, and six lateral surfaces. But it is readily seen that each lateral surface usually makes contacts with *two* cells—sometimes with only one, sometimes with three, yet on the average with two—so that there are twelve lateral contacts. These, with the two diaphragms, complete the count of fourteen. There are, however, innumerable exceptions, and it is expedient to verify our premises.

In a recent paper on the epidermal cells of the cucumber, we have discussed, with the aid of a mathematician, the geometrical requirements of an epithelial mosaic.[1] Thus we are prepared to find that the average number of sides of cork cells in cross section—that is, in a tangential section of cork *in situ* on the tree—is slightly less than six, the deviation depending on the frequency of tetrahedral angles. Such angles, or places where four cells meet at a point, are somewhat more common in the thick-walled and apparently less mobile cork cells than in those of cucumber rind when cut in the same plane. A count of the sides of one thousand cork cells yields results shown in the accompanying table. Though less than half of the cells are hexagonal, the average number of sides is 5.978. Accordingly no error has been made in assuming that the typical cork cell is six-sided in cross section.

1000 CORK CELLS IN CROSS SECTION

Number of cells with						
4 sides	5	6	7	8	9 sides	Average
18	250	491	213	27	1	5.978

Turning next to the vertical sections of cork cells, it is seen that they, too, are commonly hexagonal. Of a thousand taken at random, 521 were hexagons. But tetrahedral angles are more frequent in this plane than in the other, so that the average number of sides is only 5.877. The distribution of the various types of polygons, yielding this average, is shown in Table 2.

1000 CORK CELLS IN VERTICAL SECTION

Number of cells with							
3 sides	4	5	6	7	8	9	10 sides
2	50	241	521	152	31	2	1

What is perhaps a typical vertical section of a cork cell has been drawn in Fig. 1, *g*. It is oriented so that its "diaphragms," or inner and outer surfaces, are above and below in the picture. Each lateral surface is in contact with two cells. With the production of a tetrahedral angle, one of these surfaces would be eliminated. Thus cell *a* in the figure is in contact with cell *e*,

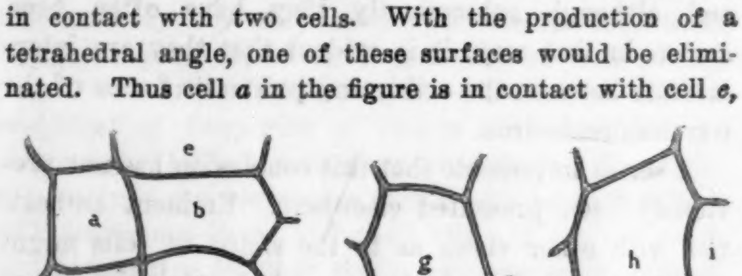

FIG. 1

and *f* with *d*, but cell *c* has lost the corresponding contact with *b*, and cells *a*, *b*, *c* and *d* meet at a point. Cell *b*, therefore, has only one contact on its left side, which is true also of cells *a* and *i*. But cell *h* has three contacts on its right, as would be true of cell *a* if it should expand toward *d* and thus avoid the tetrahedral

[1] *Anatomical Record*, 1928, 38: 345–350.

angle. Three lateral contacts are not rare, and sometimes four may be observed; the only decagonal cell encountered had four contacts on both sides.

Since the average cork cell in vertical section has 5.877 sides or contacts, and two of these are the top and bottom diaphragms, it follows that the average number of lateral contacts is one half of the remainder, or 1.938. The average number of sides in cross sections of the cell was found to be 5.978. Accordingly the average total number of contacts per cell, $(1.938 \times 5.978) + 2$, is 13.59. That this average is not precisely 14 is due to the frequent elimination of a surface accompanying the production of a tetrahedral angle. The computation indicates that 40 per cent. of the cells have lost a side in this way.

Pending the outcome of reconstructions which are now being attempted, the cork cell as a whole may be pictured provisionally as follows. An orthic tetrakaidecahedron is shown in Fig. 2, and beside it a prismatic tetrakaidecahedron of the same volume and of minimal surface for the prismatic form. A shorter or taller prism would have greater surface for its volume. Cork cells, according to the season of the

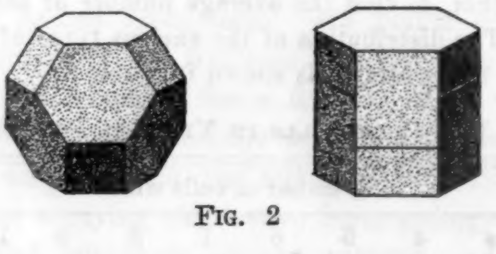

FIG. 2

year, are both shorter and taller, relatively, than the prism here pictured, which, however, is well within the limits actually observed. Although cork cells were described and figured by Hooke as if their lateral sides were flat, *i.e.*, as if they were true prisms, and although subsequently they have often been drawn in that way, it is evident that they are intermediate between the orthic and prismatic forms of the tetrakaidecahedron.

It seems impossible that this conclusion has not previously been presented elsewhere. Eminent authorities with other views as to the shape of cells might readily be cited, and also scores of cytologies where one looks in vain for a correct statement of this fundamental matter. What, however, is less obvious is the further conclusion which we have presented in other papers, namely that when a tetrakaidecahedral cell divides, whether transversely or vertically, it will produce a pair of cells each of which has eleven sides, or together twenty-two sides—an increase of eight over the original fourteen. At the same time six surrounding cells each receive an added side, making fourteen new surfaces the result of a cell division, and thus maintaining the average count of fourteen. This result, so characteristic of cells, is simply the necessary outcome of the avoidance of tetrahedral angles in every plane; and this avoidance is indeed the entire morphological explanation of the tetrakaidecahedral form. If tetrahedral angles are avoided to the *maximum possible extent*, the geometrical patterns shown in the figure will be produced. The shape becomes therefore a measure of surface tension. If, on the average, the cells are hexagonal both in transverse and vertical section, nothing in biology is easier than to prove that their average number of contacts with surrounding cells is fourteen.

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Orientation, differentiation and cleavage in the early development of the egg: EDWIN G. CONKLIN. Thirty years ago I called attention to the importance of "Protoplasmic Movement as a Factor in Differentiation" (1899). Since that time many other studies have served to confirm the importance of such cytoplasmic movements in the orientation and localization of developmental processes in eggs and cleavage cells. The actual mechanism of such movements is largely unknown but they may be stopped or modified by cold, pressure, various chemical substances, absence of oxygen, etc. On the other hand strong radiation with ultra-violet light, with X-rays or with radium does not modify appreciably these intra-cellular movements of the cytoplasm, and even a direct current of 200 mil. amp. acting for several hours has apparently no effect on these movements.

During the past summer I found that the normal movements within the eggs and cleavage cells of Crepidula plana could be greatly modified by subjecting them to a temperature of approximately 0° C. for a period of from four to six hours. The first noticeable effect of such treatment is the suppression of the vortical or rotary movements within the cells and the consequent failure of the cell body to divide and the cell contents to assume their usual positions. A second effect is the formation of many local aggregations of finely granular cytoplasm. This "hyaloplasm" or "ground substance" is normally found in the cortical layer, the asters and the astral radiations of the Crepidula egg but low temperatures (or hypertonic solutions) cause it to gather into patches or islands.

If such eggs are then returned to normal conditions some of them may develop quite normally, especially if they were in the resting condition at the time of the experiment, or if the temperature was low enough to stop all developmental processes. But if they were dividing at the time of the experiment or if the temperature was not low enough to stop all differentiation the further development is very abnormal, owing to the fact that different developmental processes are differently affected. Thus nuclear growth and division may pro-

ceed when division of the cell-body has been stopped, with the consequent formation of multi-nuclear cells; or cell-division may be limited to the portion of the egg which is richest in cytoplasm, while the yolk-containing portion remains unsegmented.

Due to the fact that typical cytoplasmic movements are interrupted mitotic figures are often out of proper position, with the result that the direction of cleavage and the size and quality of cleavage cells are abnormal. Thus the first cleavage spindle frequently lies in or near the chief axis of the egg instead of at right angles to it, in which case the first cleavage is equatorial instead of meridional and subsequent cleavages are limited largely if not entirely to the upper one of the two cells.

If the first cleavage had occurred normally before the experiment, the spindles for the second cleavage may be in any position with respect to the egg axis or the first cleavage plane; thus both second cleavage planes may be parallel with the first, giving rise to four cells in a row, or one cell of the two-cell stage may divide at right angles to the other. In many cases the spindles for the second cleavage occupy exactly the positions they take in the normal third cleavage, with the result that two micromeres are separated from two macromeres by a dexiotropic division. In later cleavages of such eggs a second set of micromeres is given off in a laeotropic direction, a third set in a dexiotropic direction and all subdivisions of these micromeres take place in a normal way, except that because of the omission of the second cleavage there are only two macromeres and consequently two micromeres of each set, instead of four as in normal eggs. In short the second cleavage has been permanently omitted without otherwise changing the normal course of development. This indicates that cleavage and differentiation may be more or less independent; cleavages may be omitted or additional ones may be intercalated, as I have found in other experiments, without changing the regular course of differentiation.

One of the most striking instances of the separableness of cleavage and differentiation is found in the eggs of the ascidian Styela partita. Fertilized eggs of this ascidian in which the nuclei divide but the cell-body does not sometimes undergo partial development which in some respects is similar to that of normally segmenting eggs. The areas of cytoplasm which normally give rise to ectoderm, mesoderm, and endoderm are typical in position and staining reactions in such egg-embryos and the nuclei in these different areas are similar in size and staining to those in the ectoderm, mesoderm and endoderm of normal embryos. Sometimes in later stages cell walls form around some of these nuclei, thus giving rise to typical cells of ectoderm, mesoderm, endoderm, or notochord. Finally at the time when normal larvae are undergoing metamorphosis these egg-embryos undergo corresponding changes in staining reactions.

Such unsegmented egg-embryos never take the shape of normal embryos or larvae; the gastrula invagination, the elongation of the embryo and other typical form changes evidently depend upon the formation of cell-walls, and upon the subsequent movements of cells. No differentiations occur in eggs in which the nucleus does not undergo repeated division. During these divisions a large amount of nuclear material passes from the nucleus into the cytoplasm, while a reverse movement of material from the cytoplasm into the nucleus takes place during the resting period. This interchange between nucleus and cytoplasm is an essential feature of chemo-differentiation. On the other hand the orientations of development are the results of typical movements within cells, and these two processes can be separated experimentally.

Long ago F. R. Lillie (1902) found that under experimental conditions differentiation without cleavage might occur in the eggs of the annelid, Chaetopterus. My results on the differentiation of unsegmented eggs of the ascidian are essentially similar to Lillie's.

The production of dwarf larvae from fragments of the annelid egg and the problem of localization: EDMUND B. WILSON. As is well known, the unfertilized eggs of sea-urchins and certain other animals may be fragmented during or subsequent to the maturation period and the fragments, upon fertilization, may develop into complete dwarf larvae. It is also known, from both observation and experiment, that some of the most fundamental operations of localization take place during the maturation-fertilization period. As yet this period has been insufficiently explored by experimental methods, especially in case of the more extreme types of so-called determinate or mosaic cleavage and development, of which the annelid egg offers a classical example. Previous experimental studies on egg-fragments in annelids include only some brief notes by Delage on *Lanice* (1899) and an important work of F. R. Lillie on *Chaetopterus* (1909). In both cases it was found that the first cleavage of the fragment is unequal in the same proportion as in whole eggs. Neither observer followed the development beyond this point; but Lillie indicated the importance of his discovery for the problem of localization, while Delage figured a dwarf larva derived from such a fragment. The writer has followed in *Chaetopterus* the development of fragments of various sizes and contents obtained by Lillie's method of centrifuging the whole eggs early in the maturation period. On being fertilized such fragments—large and small alike, if not too small, and irrespective of their visible contents—may undergo complete development and produce actively swimming dwarf larvae. In a large proportion of cases the cleavage-pattern of the fragments is practically identical with that of the whole egg in respect to the arrangement and size-relations of the blastomeres and the typical alternation of clockwise and anti-clockwise spiral cleavages. Though the dwarf larvae are often abnormal in various degrees they usually show certain of the normal structures (including very commonly the apical flagellum) and some of them closely approach the normal whole larvae in form, structure and mode of swimming. These results closely parallel those earlier obtained by the writer in case of the nemertine *Cerebratulus* (1903)

but are more striking because of the asymmetrical and more highly differentiated pattern of cleavage in the annelid. The question remains undecided whether or not fragments from any region of the egg may produce a complete dwarf, as seems to be the case in the nemertine. The annelid egg may be like that of the mollusk *Dentalium* (Wilson, 1904), which, even before maturation begins, contains a prelocalized area in the lower hemisphere, perhaps equivalent to an "organizer," the presence of which, wholly or in part, is essential for the complete development of an egg-fragment. No evidence for this was, however, found beyond the problematical fact that the first cleavage of the fragments may take place either with or without the formation of a polar lobe. In any case it seems probable, alike in case of the nemertine, the mollusk and the annelid, that at a sufficiently early period all protoplasmic regions of the egg are equipotent and that localization is essentially an epigenetic process. Further light on this question may be expected from a study of fragments of fertilized eggs of the annelid at intervals during the maturation-fertilization period, such as has been made in the nemertine by Yatsu and by Zeleny. It is hoped to make such a study hereafter.

Are there genetically based mental differences between the races? C. B. DAVENPORT. While it is commonly recognized that the different races of mankind differ in various morphological characters, it has long been contended that there is no good evidence that these races differ in mental capacity; that is, that they are unlike in inborn, genetic traits that belong to the mental sphere. That dogs differ in innate instincts and mental traits no one denies. But humans, it is thought, may be exceptional in this regard. To test this matter a number of Negroes, Whites and hybrids between them, all living on about the same social level and having about the same education, were subject to certain mental tests. Some of these related to sensory discrimination; others to such elementary things as ability to fit blocks to a form board opening, to copy geometric figures, to draw a man, to repeat a series of numbers, to show the difficulty in absurd sentences, to meet the Army Alpha tests. First of all, the scores on the mental tests, in general, follow the law of variation of physical characters. In some mental tests that seem to be good tests of innate capacity there is the same sort of difference between the races that physical measurements show. Thus in discrimination of pitch and of rhythm by the Seashore test the full-blooded adult Negroes did clearly better than the adult Whites. On the other hand, in sense of harmony there is no certain difference. In copying geometric figures the adult Whites are much superior to the colored groups. In drawing a man without a copy the adult Whites did significantly the best of the adult groups. In reconstruction of a manikin the adult Whites finished in much the shortest time of all adult groups and made the fewest errors. In interpreting the form of the hole that would result from opening out a notched paper the adolescent and adult Whites were superior to the other-colored groups. In the form board test, the substitution test, the cube imitation test, criticism of absurd sentences and in the Army Alpha tests of common sense, synonyms and antonyms, restoring pied sentences and general information, the Whites are clearly best. In the other Alpha tests the differences between the groups are not surely significant. On the other hand, in ability to repeat seven figures, not the Whites but the hybrids seem to be superior. One may conclude: first, that races differ in innate mental traits as really they do in physical characters; second, that when full-blooded Negroes and Whites of the same social status, occupation and education are compared the Negroes show a superiority over the Whites in at least certain parts of the field of sense discrimination. In ability to retain and reproduce a series of figures they seem to be at least equal, if not superior, to the Whites, but in tests involving some organization, foresight and planning, as in the form board test, in drawing the figure of a man, in reconstructing a manikin, in the cube imitation test, as well as in certain of the Army tests involving common sense and something of a logical faculty, the Negroes seem to be inferior to the Whites. The fact that, in general, the grades of the Browns are strictly intermediate between those of Blacks and Whites in the case of mental traits, exactly as in the case of physical traits, seems to be a fact of especial importance, for the Blacks and Browns live side by side in rural Jamaica and, indeed, they can frequently be distinguished only by their pedigree. Therefore difference in social status or training can hardly be responsible for the fact that Browns tend in their mental reactions toward the Whites. We are driven to the conclusion that there is a constitutional, hereditary, genetical basis for the difference between the two races in mental tests. We have to conclude that there are racial differences in mental traits.

Immunity relations between female parent and offspring: THEOBALD SMITH. The communication deals with two routes for the transmission of protective antibodies among mammals from female parent to young—the placenta and the udder. In some species it is one route, in some the other that predominates. The withholding of these protective substances in the case of calves by feeding ordinary milk in place of the first milk or colostrum is followed by prompt disease and death in three fourths of the animals so treated. The protection in the colostrum is referred to antibodies accumulating in the quiescent udder derived from the blood before parturition. The blood serum of the cow is only partially protective. The main agent of disease during the first few days is *Bacillus coli*. A serum prepared by injecting cows with *Bacillus coli* protects all calves against the early diseases when the serum is fed in place of the first milk. This fact militates against the view that vitamins are the chief protecting factors in the colostrum. In the calves fed immune serum certain diseases may appear in the second month of life in one third of the animals. This indicates a lack of protection in directions other than that directed against *Bacillus coli*.

(*To be continued*)